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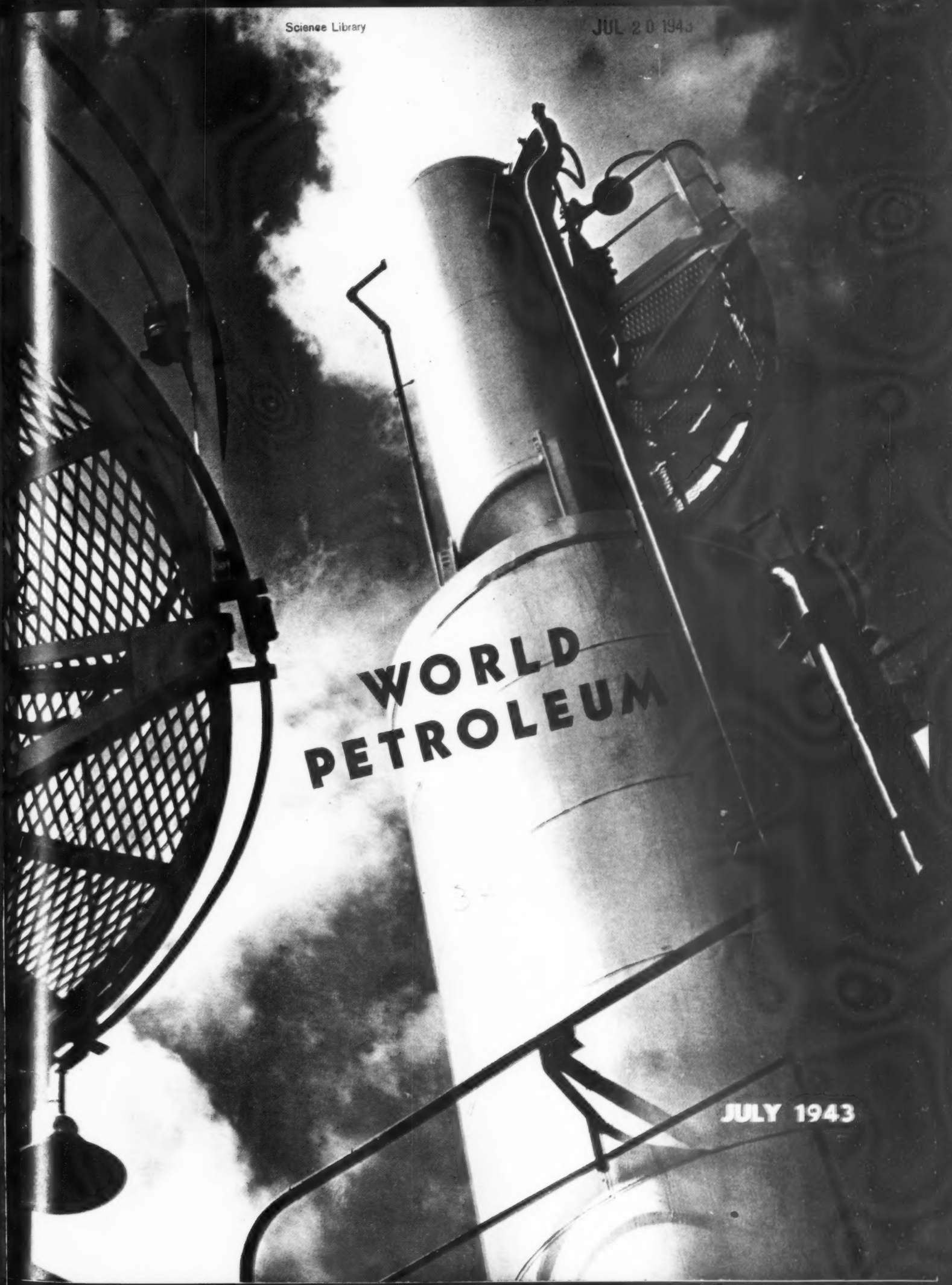
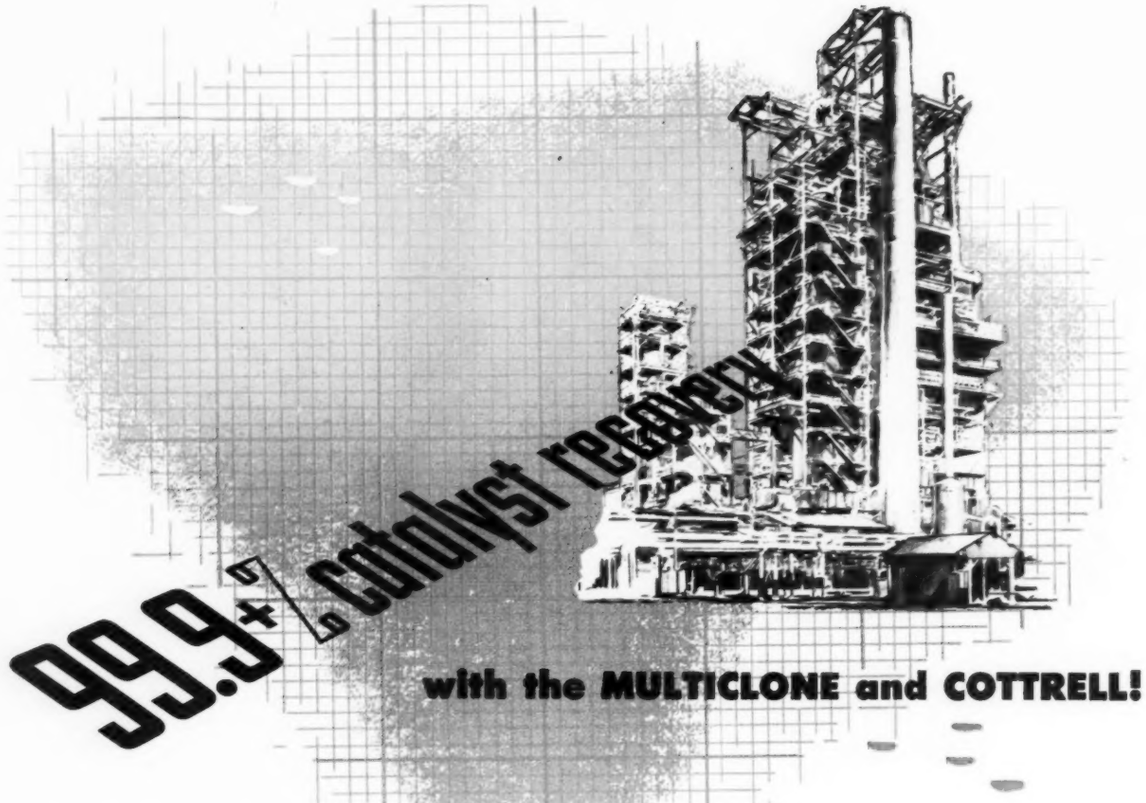


WORLD PETROLEUM

JULY 1943



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Cracking unit towers at the Continental Oil Company's refinery. Photo by Ulric Meisel.

EDITORIAL

FALLACY OF SUBSIDIZED DRILLING

DECISION of the executive branch of the federal government to go all-out for subsidies in an effort to meet the deficiencies and mend the earlier shortcomings of its price control measures has made the subject an outstanding issue among those affecting the home front. Despite a rising tide of opposition in Congress and throughout the country to the wholesale employment of this device the conclusion reached by administrative officials, even those who appreciate the dangers in the subsidy system, apparently is that in the situation that has been allowed to come into existence it affords the only practicable means left of keeping the inflationary trend, already far advanced, under even partial control. Therefore they cling to food subsidies.

To the members of the oil industry the proposed expansion in the use of subsidies is of more than academic interest because of the recommendation put forward by the federal Price Administrator that they be used to extend the discovery of petroleum deposits and to assure the increased production of oil to meet the swiftly rising demands of global war. The very fact that such a plan should have been proposed for the encouragement of oil search shows to what extent it has taken possession of the minds of government officials. If there is any field of endeavor in which the offer of subsidies is less likely to bring satisfactory results than in exploration for oil it is difficult to conceive what it can be. The analogy of increased production of ores which has been cited in support of the plan does not apply. In the cases of mines that could not be worked because the cost of bringing out ore is higher than the price at which it is permitted to be sold it is relatively simple to determine the results that can be obtained in the way of enlarged output by a definite expenditure. In dealing with commodities which are wholly or principally imported the factors involved are known and the administrative machinery is relatively simple to set up and operate. It is in dealing with conditions such as these that wartime subsidies have been applied with measurable success by other governments, such as those of Great Britain and Canada.

By way of contrast the attempt to locate oil fields by wildcat drilling is essentially an expedition into the unknown. Even when guided by elaborate geological surveys it involves elements of risk with which private initiative can cope much better than cumbersome governmental organizations. The selection of drilling sites, the decision of the methods and equipment to be employed, the determination whether to stop the drill at a certain depth or to continue to lower horizons at a possible doubling of the cost originally estimated are matters that can best be decided by men who are risking their own money in the venture. These and scores of other questions that inevitably arise in connection with exploratory drilling call for instant decisions which a governmental organization by its very nature is incapable of rendering with the necessary degree of promptness. To provide the strict supervision of operations and expenditures regarded as essential where government participation is concerned would require a huge organization made up of technical experts and bound up by interminable red tape in securing the approval of its various bureaus for a specific proposal. The alternative of indiscriminate subsidization of all wildcatting is too wasteful and ineffective to be considered if the purpose in view is the location of productive fields and not merely the drilling of dry holes.

In a government such as that of the United States the intrusion of politics into any undertaking that involves the expenditure of hundreds of millions of federal funds is practically inescapable. The award of government money to wildcat drilling would be particularly exposed to such influences because there is no part of the country in which believers in the possible existence of oil in their neighborhoods are not to be found regardless of geological conditions. Every section would demand a share in the expenditure. Pressure to induce the appropriation of funds for every such area would be applied through methods well established in Washington.

To a person at all familiar with the conditions attending oil discovery the objections to attempting it through governmental operation or participation are too numerous to find mention in a brief discussion of the subject. They are so numerous and so obvious that the proposal itself must be regarded as an attempt to sidetrack the tried and logical method of encouraging exploration by permitting a price for oil that will induce drillers to undertake the heavy risks involved in the operation. As for the proposal for a general resort to subsidies the growing sentiment of the country is that they should be kept within the limits of actual war necessity and abandoned as soon as the return of peacetime conditions permits.

NATURAL GASOLINE INDUSTRY

Geared to the War Effort

As DEFINED in a presidential address before the Natural Gasoline Association of America, the natural gasoline industry has three interrelated divisions, of which one is concerned with the production of natural gasoline which is mostly sold to refiners, another which produces liquified petroleum gases (L.P.G.) for sale to domestic and industrial consumers, and a third which is concerned with gas cycling in condensate pools.

The latest authoritative statistics show that in sixteen of the United States there are 572 plants producing natural gasoline and related products on a scale large enough to be considerd commercial. Naturally, the larger number, 145, of these plants are located in the greatest oil state, Texas. Oklahoma is next with 101, then California with 86, West Virginia with 78, Pennsylvania with 69 and Louisiana with 29. Thus, 85 percent of the industry in found in six states.

About 150 of the 572 natural gasoline plants produce L.P.G. as well as natural gasoline. Among these 572 plants are 32 which operate in condensate (or distillate) fields where gas cycling for pressure maintenance is the rule. Of these 32 gas cycling plants 29 are in Texas, 2 in Louisiana and 1 very small one in New Mexico. As a practical matter, the condensate branch of the natural gasoline industry is confined to two areas in the Gulf Coast, one in Texas and the other in Louisiana.

On the production side, the natural gasoline industry in 1942 had a capacity for daily production of 11,300,314 gallons of natural gasoline, and 3,564,714 gallons of L.P.G. The gas cycling plants are credited with a daily capacity for 28,230 bbl. of condensate. The yearly production figures for 1942 are:

Natural gasoline	2,051,616,000	gallons
L.P.G.	674,478,000	"
Cycle products	665,532,000	"

Before World War II the normal function of the natural gasoline industry was chiefly to take care of the more volatile products issuing from producing oil wells, particularly wells with large gas/oil ratios from which natural gas is supplied through gas companies for consumption as fuel. This "casinghead gas" is usually heavily loaded with a mixture of volatile hydrocarbons such as propane, butane and pentane, that are easily condensed to liquid form, and as liquid would create a nuisance in the gas pipes. Re-

General view of the East Texas plant of the Sabine Valley Gasoline Company.

Above: Memphis Natural Gasoline Co. plant. Photo courtesy Clark Bros. Co.

moval of these liquids from the "dry gas" is the first object of the natural gasoline plant; the second object is to furnish the condensed mixture of hydrocarbons to customers who can use them. These customers are, in the first instance, the petroleum refiners who need volatile products to give the necessary volatility to the gasoline they sell as automobile fuel. The "natural gasoline" supplied by the natural gasoline manufacturer is an excellent blending material for this purpose. The other normal outlet for the natural gasoline manufacturer is the market for liquified petroleum gases which is created by the demands of consumers who do not have ready access to supplies of natural or manufactured gas for domestic or industrial use. For these consumers the most volatile of the liquids are condensed under pressure and sold in drums or tanks, from which gas may be obtained by turning a valve.

From a consideration of the nature of the two wings of his market it is easy to deduce that the pre-war natural gasoline manufacturer was essentially a "vendor of volatility." Since the demands of the refiners for volatility were at times irregular and uncertain the natural gasoline manufacturers were often left with too much of some fractions and too little of others, and it not infrequently came to the point where surplus propane and butane (now so precious) had to be burned for lack of a market. Some operators who became dissatisfied with the natural gasoline market could and did branch out into the motor fuel market, or to the production of specialties or raw products for the chemical industry.

Like many other industrialists, the natural gasoline men have a vision of what would be an ideal state for their industry: a perfection of refining equipment and operations such that all of the raw materials available might be processed into fractions demanded by markets that have been developed to use these fractions. This would be the true conservation that all wish the petroleum industry could practice. However, the pre-war natural gasoline industry was a considerable distance from this ideal, but under the impact of the war it has been acquiring a character that may project it into new ranges in the post-war era.

The first effects of the war on the natural gasoline industry were somewhat unfavorable. The curtailment of automobile traveling and the rationing of motor fuel decreased the consumption of gasoline, and this, together with moves to reduce current octane numbers of this fuel, decreased the demand for the volatility represented by natural gasoline on the conventional 26 lb. basis. On the one hand the expansion of the industry was being limited by the slackening of the rate of discovery of flush new oil fields, while normal depletion in the older fields made the installation of new plants and the modernization of existing plants financially uninviting. Installation of natural gasoline plants in new but relatively inaccessible fields has been retarded, first, by the difficulty in procuring scarce essential materials, and secondly by the increased difficulty of transporting the light products in which the industry specializes.

The advent of war imposed a new situation on the natural gasoline industry, and invested it with a highly important responsibility. Along with, and partly in substitution for his principal role as a purveyor of volatility for automobile fuel, the natural gasoline manufacturer has had thrust upon him the duty of making an all-out effort to furnish octanes for fighting aircraft, and the raw materials for synthetic rubber. The production of these two vital necessities is primarily a function of the crude petroleum refining industry, but without the help of the natural gas producers the crude refiners could not possibly deliver the necessary quantities of either. Military aviation gasoline indeed requires volatility, but over and beyond that it requires the power represented by high octane numbers that are found only in special products which the refiners must manufacture from such materials as they can find. An important source of raw materials for 100 octane number aviation gasoline is gas containing the C_4 and C_5 hydrocarbons that are formed in the process of cracking crude oil for motor gasoline, lubricating oil and other necessary products. The C_4 hydrocarbons are also the starting materials for the manufacture of synthetic rubber. But all the gases produced in cracking operations of all the refineries is not nearly enough to meet the combined requirements of the synthetic rubber and the aviation gasoline programs.

The natural gasoline industry has been called on to make an utmost effort to fill the gap. The main product of this industry is rich in the C_4 hydrocarbons, normal and isobutane, which are main foundation materials for both 100 octane number gasoline and synthetic rubber, and is rich in the C_5 hydrocarbons, pentane and isopentane, that are prime ingredients of aviation gasoline base stock. These principal constituents of natural gasoline, which in pre-war days derived their chief importance from their volatility, now become important as major sources of power for fighting airplanes.

The government has therefore laid upon the natural gasoline industry the duty of making available to the refiners the maximum possible amount of the butanes and the pentanes, which formerly were often a drug on the market because of a limited or uncertain demand for volatility. There must now be no more burning of these materials to get rid of them in any case or place where it is possible to save them; a sure market is available for all that can be delivered.

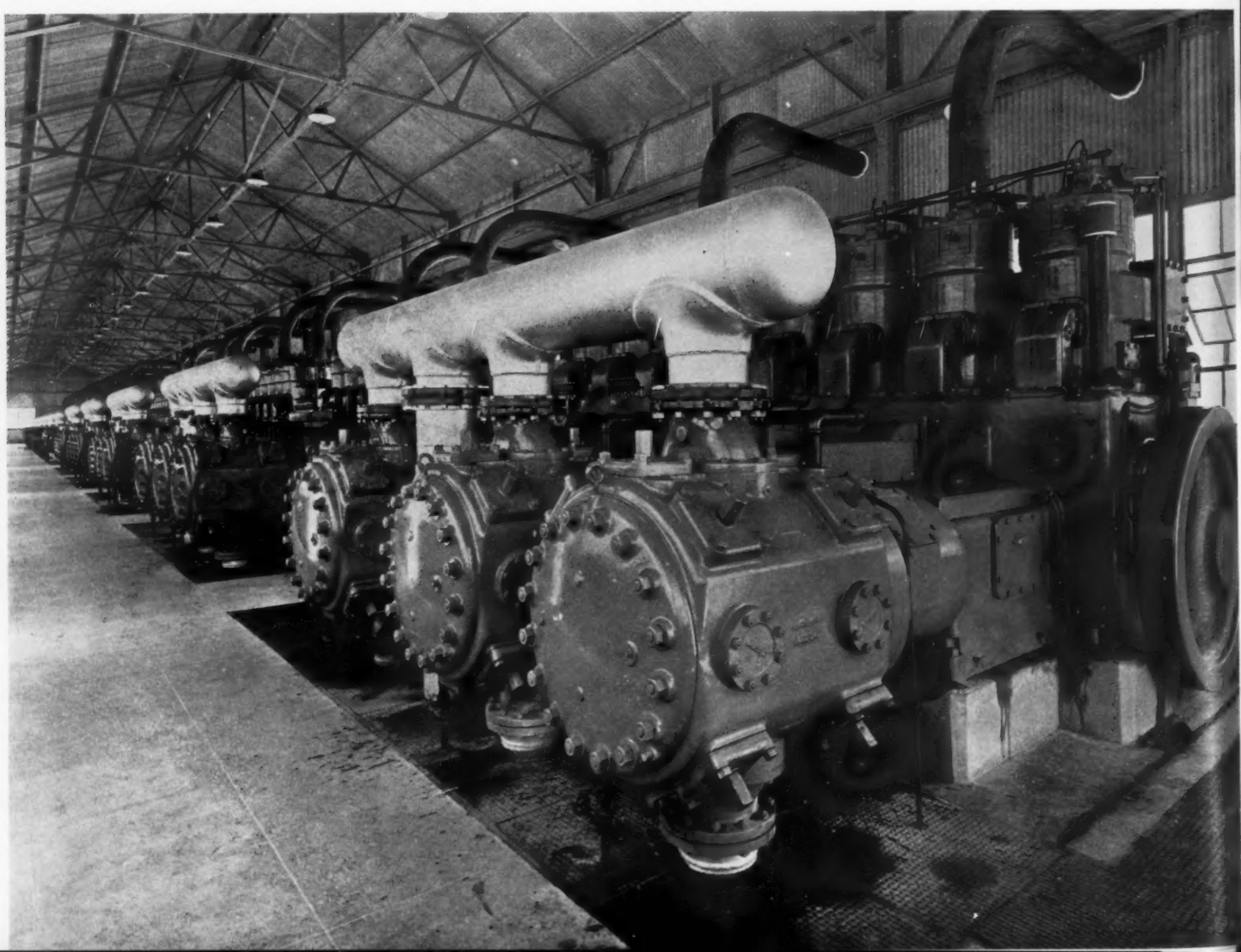
The manner in which the industry is meeting the demand varies with the situation of the individual producers. Very many of the country's natural gasoline plants are small affairs, with not enough wet gas available to them to warrant the installation of equipment for segregating the important hydrocarbons from the less urgently needed products. The most that can be expected of the smallest plants is that they will intensify their natural gasoline and L.P.G. operations, and avoid waste. The refiners will now take all the natural gasoline that is offered and all available L.P.G. is being avidly sought both by the refiners and other consumers.

However, the situation has demanded that the natural gasoline industry carry its participation in the war effort beyond an intensification of its usual operations. In this matter, as in so many other conjunctures arising out of the struggle against our enemies, time is of the essence. The critical hydrocarbon materials for 100 octane-number gasoline are needed at once, and in quantities exceeding the capacity of the refineries to turn them out with the equipment on hand.

Instead of sending the natural gasoline and the L.P.G. to the refinery for extraction of the butanes and the pentanes, time can be gained by effecting the segregation of these hydrocarbons at the point of origin. The natural gasoline plant is essentially a fractionating plant, whereby the natural gasoline and the liquifiable hydrocarbons are separated from the permanent gases and the heavier liquids. Now, the point is to make a sharper separation. Instead of lumping the normal butane, the isobutane, the pentane and isopentane together in the natural gasoline or commercial L.P.G., these four materials must as far as practicable be individually segregated. The isobutane and isopentane thus produced will pass directly into the alkylation plants for condensation with refinery olefins to produce the isooctane (or in general alkylate) that forms the chief ingredient of aviation gasoline; the normal butane will go directly to the refinery for catalytic cracking to produce butylene for synthetic rubber and as an additional supply of olefin for alkylation; or it may be catalytically isomerized to produce additional isobutane for the insatiable aviation gasoline program. Among other uses pentane will go into aviation gasoline base stock, which will be raised to fighter grade by addition of alkylate or isomerate, tetraethyl lead, and boosters such as isopropyl benzene.

The installation and operation of superfractionation equipment has therefore become the order of the day for all components of a natural gasoline industry geared to the war effort. This will not be practicable for many small plants except in rare cases where central fractionating equipment can be installed, but all who can are being urged to do it. The urge in this direction has become more pronounced now that the production of aviation gasoline has been found to be lagging, or rather since it has been discovered that the Army and Navy require vastly greater amounts than they previously estimated. The

Below: Compressor station at the El Paso Natural Gasoline plant. Photo courtesy Clark Bros. Co.



output of fighting aviation gasoline must be stepped up, which means a stepping up of the production of the necessary raw materials.

The insistence of the government on stepping up the production of this vital raw material has not been limited to a recommendation that natural gasoline plants install a superfractionator, or "butane splitter." What is mostly wanted is isobutane to feed the alkylation plants. Refinery gases contain practically none of this bottleneck material, and the amount of it that naturally occurs in wet casinghead gas is far from sufficient to meet the requirements. The most that a superfractionator can do is to separate the normal butane from the isobutane; both may then be shipped to the refinery, where the field isobutane is alkylated and the normal butane is catalytically isomerized to produce more isobutane.

This shipping of normal butane to a distant isomerizing plant involves a certain amount of lost motion. There are weighty reasons why the isomerizing should be done at the natural gasoline plant. In the first place after the natural gasoline manufacturer has acquired a superfractionator only a relatively small additional investment will be required to install equipment for butane isomerization. The separation of the butanes and the isomerization of all or a part of the normal butane to isobutane then become closely connected stages in one continuous process, involving little or no waste of time and motion.

The authorities have taken note of these possibilities, as they well might do in view of the fact that every additional barrel of isobutane will mean four more barrels of fighting grade aviation gasoline. A "Butane Isomerization sub-Committee of the Aviation Gasoline Advisory Committee" of PAW has been set up to stimulate the interest of the natural gasoline manufacturers in this proposition. In the first place, assurance is given that all who can will have a chance to participate in this development. The demand for isobutane is urgent and a sure market is at hand. The Butane Isomerization sub-Committee is giving all possible assistance in the way of technical advice. At the present writing 32 natural gasoline plants have embarked on butane isomerization projects. The combined rated capacity of these 32 butane isomerizing plants is 25,500 barrels of isobutane per calendar day, equivalent to 102,000 bbl./day of 100 octane number aviation gasoline. The smallest of these plants was built for a rated capacity of only 68 bb./day, the largest for 2850 bbl. Among the 10 plants completed by April of this year are several that have attained an output

Typical low pressure oil absorption plant with stabilizer. View shows absorber, still and stabilizer tower, with heat exchangers and piping. This plant was designed and built by the Engineering and Construction Division of Frick-Reid Supply Corp.

more than double their rated capacities.

In view of the inexperience of most operators in this line, the sub-committee collects and disseminates technical information on the process; the operators furnish the sub-committee with monthly reports on their operations; these reports are mimeographed and circulated for the benefit of all, and operators' group meetings are held for round table discussions. The door is still open for new entrants, and any reasonably sound project has a good chance for approval.

The equipment of a butane isomerizing plant consists essentially of a "butane splitter" and a catalyst chamber for isomerizing the normal butane to isobutane. As stated above, the "butane splitter" or superfractionating column is the most expensive portion of the equipment and would have to be installed anyhow if the isobutane is to be segregated for any purpose. After the separated normal butane leaves the superfractionator a "promoter" is added to it on the way to the catalyst chamber. The products of catalysis are mostly isobutane, unreacted normal butane, and promoter. The promoter and the normal butane are recovered for recycling. The yield of isobutane per pass is 40 to 50 percent; the ultimate yield, calculated on the normal butane charged, is 90 percent or more. The catalyst life amounts to 50 gallons of isobutane per pound of catalyst, and the loss of promoter is small. The operating cost, exclusive of depreciation and patent royalties, is said to be less than one cent per gallon of isobutane. Firms which issue patent licenses are M. W. Kellogg Company, Phillips Petroleum Company, Shell Development Company, Shell Oil Company, Standard Oil Company of California, Standard Oil Development Company, The Texas Company, and Universal Oil Products Company.

Concerning the installation of plants for isomerizing normal butane it is worthy of note that quite recently a simpler and more efficient process has been introduced for this purpose. Most of the plants now in operation work by the vapor phase process, which requires that the butane feed and all reaction products be kept in vapor form while passing through a fixed bed of aluminum chloride. This process has been simplified by a liquid phase process which Shell Oil Company has had in successful factory operation since February of this year. Conversion in the new process has exceeded 55 percent, and corrosion of the equipment is less.

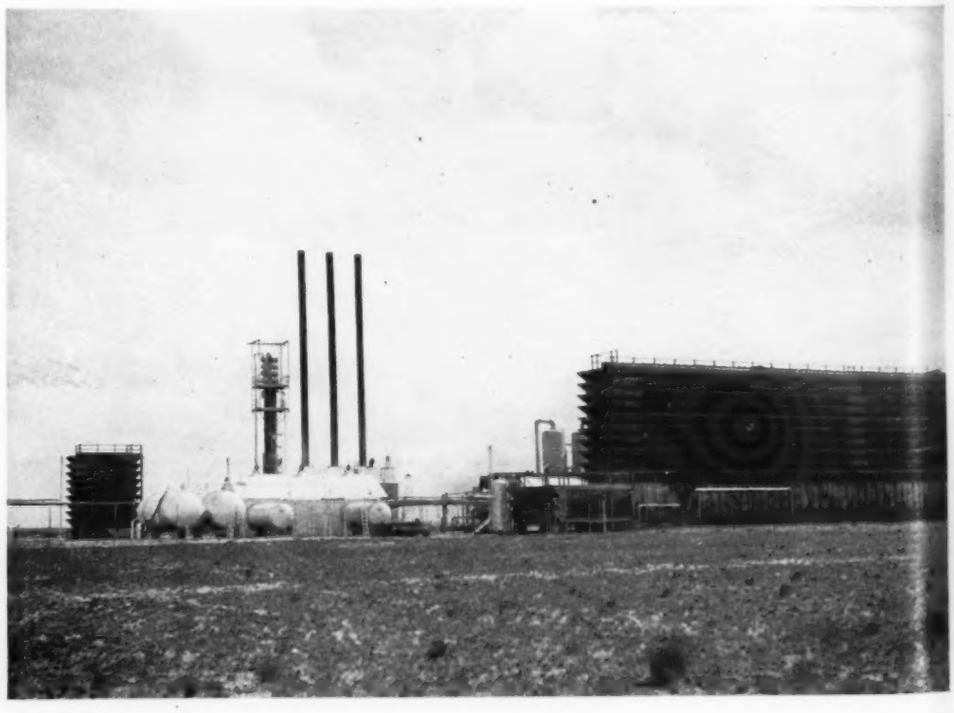
The natural gasoline manufacturers who have embarked on the production of isobutane are motivated by the natural patriotic urge to help out in a vital phase of the nation's war effort, a motive that is supported by the prospect of a sure return on their investment. No doubt, in the back of every operator's head may be a feeling that he has acquired a war baby that will pine away and die when peace comes. But there are sound reasons for believing that this new direction which the natural gasoline industry has taken contains the seeds of permanence. In the first place, the natural gasoline industry has a nearly complete monopoly, or at any rate the first call, on the available supply of the C_4 and C_5 hydrocarbons, which means that it has its grip on the bulk of the materials out of which blending agents for 100 octane gasoline are made. Instead of handling these source materials over to the crude refiners the natural gasoline manufacturer may just as well deliver them in the form of the finished blending agents. It seems to be definitely assured that civilian aviation will have an enormous development after the war, and that the automobiles of the future will run on gasoline that approximates 100 octane number; whatever the catalytic crackers are likely to do in the way of producing superoctane materials, isobutane will hardly be displaced from its present position as a bearer of octanes.

In line with this idea it has been suggested that the natural gasoline manufacturer who heeds the call for more isobutane need not limit himself to installing a butane splitter and a unit for catalytic isomerization of butane to isobutane delivery to the alkylation plants. With a little more investment he may go in for alkylation on his own account by putting the isobutane he has produced through an isobutane cracker and crack it to the extent of 20 to 30 percent. This will result in a mixture of olefins and isobutane which on passing through an alkylation or a codimer unit and a debutanizer emerges as finished blending agent.

Of course, such a program is too ambitious for the smaller natural gasoline plants, but it seems to be plainly indicated for the larger ones, particularly those associated with gas cycling operations in distillate pools. These cycling plants are the ones most favorably situated for recovering strategic C_4 and C_5 hydrocarbons. In the first place the nature of a distillate pool requires that it be operated as a unit, which permits the handling of large volumes of gas in a single plant. In the second place these distillate pools are found mostly in two areas where it is more feasible to install central fractionating plants serving different properties. After the war the distillate operators who have installed superfractionating equipment, isomerization and alkylation or codimer units will be in an excellent position to function in the post-war market for high octane gasoline and for specialties in the light hydrocarbons. The more they and other natural gasoline producers intensify this line of operations the more they will be able to utilize the heavier oils from their stills in the manufacture of motor gasoline as well as the aviation grades.

It is interesting to note that the war situation has given a new importance to propane, which is the most worrisome problem child of the natural gasoline industry. With most of the available butanes and pentanes earmarked for the synthetic rubber or the aviation gasoline programs there has been created a shortage of volatility for even the reduced amount of motor fuel that is being manufactured. This lack can be made up to a considerable extent by propane. If the war-born synthetic rubber carries the present demand for butadiene into peace times the new position won by propane will be more or less maintained.

There are few natural gasoline plants in the Rocky Mountain States: One of the largest is that of the Phillips Petroleum Corp. in New Mexico.



PREFABRICATED HOUSING

in the Post War Era

Accumulating Demand During Period of Slack Construction Plus Anticipated Industrial Expansion Will Open Wide Opportunity for Type of Dwelling of Special Interest to International Oil Industry.

NATURE'S fondness for hiding its oil resources in forbidding and sometimes almost inaccessible places often has been remarked upon. To the searchers after these hidden deposits, it seems at times as though a carefully prepared plan had been followed in making them difficult to locate in order that their discovery might be spread over the longest possible period of time and thus offset man's tendency to dissipate too rapidly the bounty stored for him through millions of years preceding his appearance upon the earth.

This may be a fanciful notion but it is unquestionably true that many important petroleum finds, particularly in the past twenty or thirty years have been located beneath desert wastes, deep in tropical jungles and in other places far removed from the appurtenances of modern civilization. As a consequence the explorers who have sought out new sources of oil supply and the operators who have developed these fields after their discovery have been able to follow no such simple procedure as drilling a hole in the ground and letting the oil flow. They have had to perform many tasks only indirectly related to the actual production of the precious fluid which was the object of their search.

Before even the start of drilling in these remote sections it is necessary to blaze trails and build roads over which machinery can be brought in, to construct living quarters for the workers, to provide a water supply, lighting and sewage disposal facilities and to see that food, sick care and some degree of entertainment is made available. If the first wildcat well or series of wells finds oil a more or less permanent community is gradually built with its full complement of homes fronting well built streets, with shops and schools and all the equipment that is considered indispensable to the social life of the Twentieth Century.

Many of the towns carved out of the wilderness of seemingly inhospitable locations in South America, the Middle and Far East possess all the conveniences and attractions of aspiring small cities in populous areas much nearer the centers of modern industrial activity. But whatever their state or size, from a few tents or shacks near a tentative drilling site to a full-fledged urban community they remain "camps" in the oil man's vernacular — a tacit recognition no doubt that in his world nothing is ever really permanent.

By the very nature of the conditions under which they are compelled to operate the oil companies whose activities extend to remote and unoccupied regions have been led to make a careful study of housing conditions and requirements. In some locations they have been able to provide attractive and comfortable homes by the use of local materials but in many places it has been found advisable to have houses and other buildings fabricated elsewhere in accordance with plans and designs prepared by housing experts to meet the climatic and living conditions under which they were to be occupied. These dwellings are then shipped to their destination along with complete plumbing and other equipment ready for immediate erection. In this way, the buildings are adapted to the environment in which they are to be placed and at the same time they incorporate all the modern conveniences to which their occupants have been accustomed at home.

In view of the great demand for petroleum products that is certain to arise after the war and the keen interest displayed by every country that holds even slight pretensions to the possession of

Left: Socony-Vacuum camp at Pariaguan, showing housing arrangement.

Below: Lago Petroleum Corp. camp for employees at Lagunillas, Lake Maracaibo.

oil deposits in the discovery and exploitation of these resources a great expansion in exploratory activity and oil field development is certain to take place. Many areas to which the geologist never has penetrated will be subjected to survey and in all probability new and important fields will be opened to development. Under these conditions the international oil industry promises to afford a broad market not only for the many kinds of machinery and supplies used in the production, transportation and processing of its products but also for the structural materials and buildings required for the accommodation of its working forces.

As a consequence of the war and the demand to which it has given rise for the construction of hundreds of camps and of whole towns surrounding war plants in previously unbuilt areas the problems of large scale housing have received much attention and great advances have been made in the design and production of prefabricated buildings to meet a wide range of conditions. As a result of the experience thus gained and the progress made it is the opinion of many authorities in the building trades that ready made homes will come into general favor not only in isolated sections where construction materials and facilities are scarce but in well settled communities as well. No longer does the factory built house advertise its origin for all to see but it compares favorably with dwellings individually designed. On the other hand its lower cost and its ability to bring the most advanced features of modern housing within reach of those with moderate incomes presents a strong appeal.

In all attempts to survey post-war development building activities are assigned a leading role in replacing present concentration on production for war. It is agreed that the demand for homes which has been accumulating during the war years will far exceed the capacity of industry to supply them by conventional methods. In meeting that situation whether in representative American towns and cities, in restoring war-torn areas or in bringing up-to-date standards of comfort and convenience to the residents of oil camps scattered around the world the prefabricated house undoubtedly will play a highly important part.

←

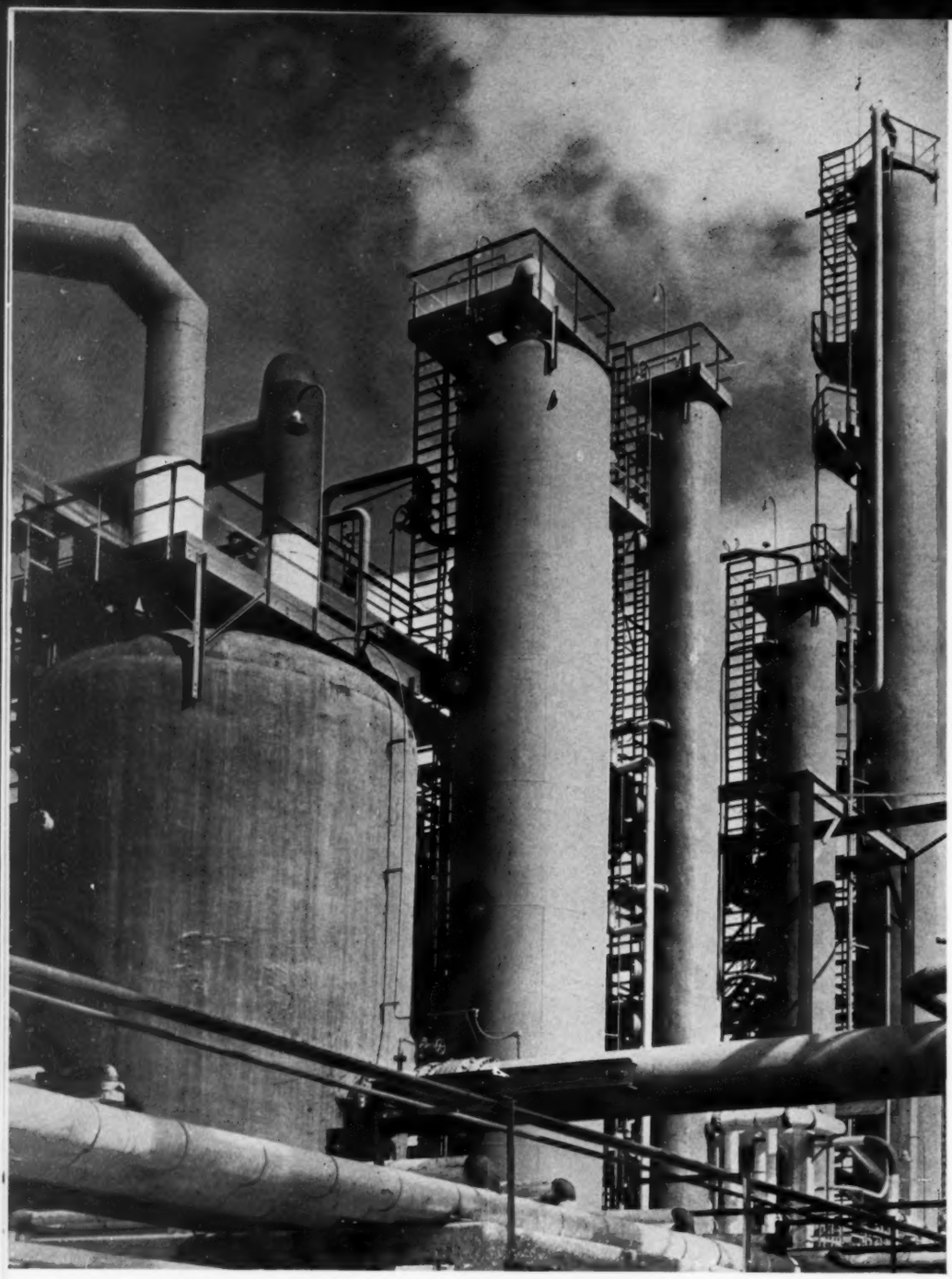
Left, top: Prefabricated homes are the answer to the housing problem of the oil industry. Erected with speed and economy, their salvable values are also very high as they can be dismantled and moved to new localities. Photo courtesy The Green Lumber Co.

Left, bottom: "Victory" housing units being assembled. The use for prefabricated housing is practically unlimited. Photo courtesy Texas Pre-Fabricated House and Tent Company.

Top: These houses lend themselves to efficient field offices, bunk houses, mess halls, and innumerable other uses. Photo courtesy Houston Ready-Cut House Co.

Above: Portion of a house project under construction near La Porte, Indiana. Photo courtesy National Homes Corp.

Left: Pholo shows all outside sections of house and most inside sections set. Photo courtesy Southern Mill & Manufacturing Co.



In these towers and reactors of the Standard Oil (N. J.) refinery at Baton Rouge, man-made rubber gets its start with the processing of petroleum refinery gas. The result is butadiene which, when combined with styrene, makes Buna S rubber.

GREAT REFINING CENTRE

Producing Wide Range of Anti-Axis Weapons

By Lorania K. Francis

Big Group of Industrial Plants at Work 24-Hours Daily Swelling Supply of Aviation Fuel, Butadiene, Synthetic Rubber and Other War Materials

DEATH and destruction to the Axis is nowhere better promised than at Baton Rouge, La., where Standard Oil Co. of Louisiana, a member of the Standard Oil Co. (NJ) group, is turning out the materials most needed for a successful conclusion of the war. Christened by Rubber Director William M. Jeffers the "cradle of the synthetic rubber industry," the Baton Rouge refinery might well be re-named the "graveyard of Axis hopes."

In this vast 1200-acre monument to American ingenuity, virtually every process which can be used to boost the output of 100 octane gasoline, synthetic rubber, toluene, synthetic alcohols and a hundred other products vitally important to the war effort, is on a 168-hour week. Twenty-four hours a day, for seven days a week, until the war ends, the continuous processes necessary for the production of war materials operate.

Although one of the world's largest refineries, the crude run at Baton Rouge, amounting to 120,000 barrels daily, represents only three percent of the refinery crude run of the country today. This fact, in itself should cause concern in enemy hearts.

The Baton Rouge refinery is a city constructed by petroleum engineers. Its skyscrapers are its lofty catalytic cracking plants, its alkylation and fractionating towers, its stills and smokestacks. Thousands of miles of pipe—enough to girdle the earth—criss-cross its surface, above and below ground. It has its own railroad, electric power plant, water supply and sewage disposal. Its "buildings" are the great plants themselves, the cracking plants, the hydrogenation and dehydrogenation units, the Perbunan and Butyl rubber plants . . . Its "suburbs" are the additional 1000 acres of tank farms that lie outside the boundaries of the refinery itself.

This is the plant that started, in 1909, as a 213-acre cotton plantation. It made its contribution to World War I, in millions of gallons of gasoline, fuel oils and lubricants, shipped from its docks on the broad Mississippi River. Nearly 20 years ago, it was chosen by the Jersey company—parent company of Standard of Louisiana—as a principal developmental center.

Crude, flowing into one end of the great system of pipes, tanks, stills and other units at Baton Rouge, is changed by the miracles of cracking, distillation and petroleum chemistry into almost any product derivable from carbon and hydrogen.

Here processed crude oil becomes high octane gasoline for aviation; incendiary bombs to paste the Axis; toluol to blow the enemy's fortifications to smithereens.

These and many other mysteries demonstrating the mastery by man of the elements at his command—rushed to fruition under the pressure of war—were revealed to a privileged group of Army, Navy and other governmental officials, to-

gether with a party of newspaper correspondents, at Baton Rouge early in June.

A self-contained unit, Baton Rouge is a series of manufacturing plants stemming from the catalytic and thermal cracking units and the hydrogenation plants. A labyrinth of pipes and skyscrapers and furnaces, flaming torches and outlandish silhouettes, the Louisiana refinery would beggar the imagination of Jules Verne.

Under the impetus of the war, the huge plant has expanded and taken on new significance. While, with the exception of its synthetic rubber installations, most of the investment involved is private capital, many of the new units are painted the khaki brown of the U. S. Army.

This does not mean, however, that Standard of Louisiana was not working on the problems of aviation gasoline and synthetic rubber well in advance of Pearl Harbor. Ironically enough, the company was—and still is—producing base stock for the manufacture of 100 octane gasoline in its high pressure petroleum hydrogenation plant, using techniques obtained from the Germans through Standard Oil Co. (N. J.)'s cartel agreement with I. G. Farbenindustrie. In this same unit, which boasts some of the heaviest industrial equipment in use in this country, many of the generators, heat exchangers, valves, pipes and other equipment installed more than ten years ago, still bear the names of German manufacturing companies. Others were built from German blueprints. The know-how for the first steps in the hydrogenation process was obtained from Germany in 1927, according to company spokesmen. It was the key to the manufacture of high octane gasoline on a large scale.

The process itself involves exposing light distillates to hydrogen gas in the presence of a catalyst and under high pressure and temperature. The original process has been greatly improved and the utility of the plant "vastly increased" since Pearl Harbor, it is explained. A main portion of the plant now is used to complete the processing of partly finished stock supplied by other refiners, with the result that the total amount of 100 octane fuel has been notably boosted.

Heavy equipment designed and manufactured in this country has long since been installed in the hydrogenation plant. This equipment, according to engineers, is far advanced from the early German designs. Officials take a pardonable pride in this fact and point out that samples of German-manufactured aviation gasolines, taken from crashed planes, test far lower than the 100 octane made at Baton Rouge.

Wartime secrecy shrouds many of the operations at the Louisiana refinery. Much of the information given out at a recent open-house which the company held for the nation's press was marked "restricted." But it is no secret that butadiene for the manufacture of synthetic rubber is being turned out in huge quantities at Baton Rouge.

The first large scale thermal type oil cracking plant for the direct production of butadiene from oil was completed a month after Pearl Harbor. One year later, a duplicate of the same unit—only more than twice the size—was ready to operate. These cracking units produce and purify butadiene for use in the production of buna rubber.

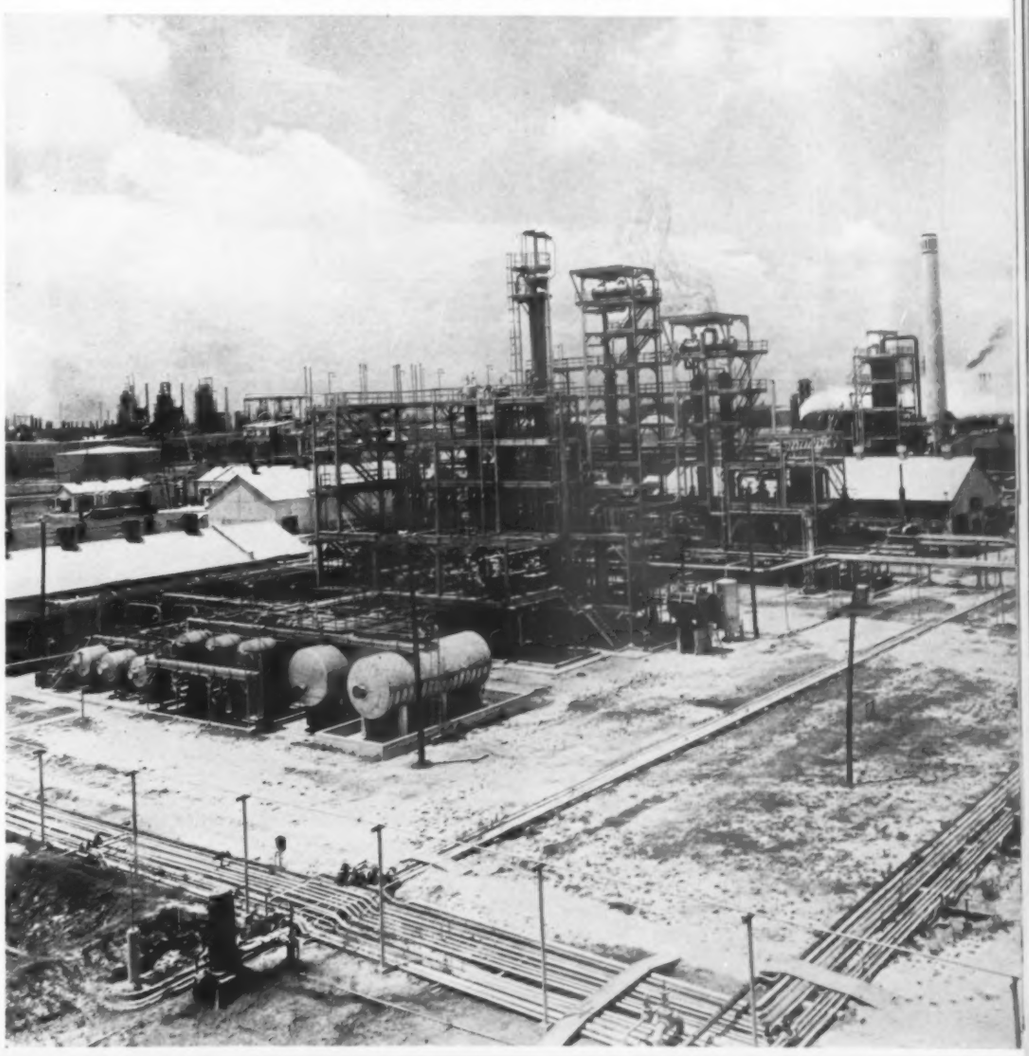
The "quickie," or refinery conversion, program—added to the original Government butadiene production program at the recommendation of the Baruch Committee—was based on this process, which, as worked out at Baton Rouge provides not only butadiene but large quantities of petroleum gases which are used in the manufacture of 100 octane, in the production of tetraethyl lead and even in the production of raw material for making Thiokol rubber. The monster new "cracker" has enlarged its operations to include production of some 20,000,000 gallons per year of synthetic alcohol.

Described as "one of the mainsprings of our war program," Standard's first fluid catalytic cracking plant, finished in May 1942, represents one of the most painstaking pieces of petroleum research ever undertaken.

Working out the process with glass equipment and cautiously experimenting until it could be carried through a half-barrel per day unit, a two-barrel per day unit and, finally, a semi-commercial 100 B/D unit, Standard was ready, in 1940, to start work on its first commercial plant. Difficulties of design and the growing scarcity of materials held up completion of the large scale plant, however, until last year. The efforts of the engineers made it possible for the completed unit to go on the line "with practically no trouble at all," and the second run covered a period of 43 days, and demonstrated capacity up to 140 percent of that called for by the design.

Conversion of the fluid catalytic cracking process to war uses, occurred almost at the outbreak of war. The plant, originally designed to improve motor gasoline quality, increase yields from crude oil and reduce manufacturing costs, was operated with a new catalyst which made possible the manufacture of 100 octane aviation base directly from the unit. Later a higher temperature was used, and this permitted the simultaneous production of increased quantities of butylene gas, which furnished the raw material for still more aviation gasoline and for butadiene and butyl rubber manufacture. The term "fluid **catalyst**" is derived from the unbelievably fine **clay** catalyst which is used in the process.

This plant which produces butadiene for Buna S rubber by steam cracking, was the first of its kind to go into operation in the United States and has been in production at the Baton Rouge refinery of Standard Oil (N. J.) since January, 1942.



The highly-successful operation of the fluid catalytic cracking plant, and improvements in design which reduced the number of instruments and exchangers needed, led to the standardization of the design. About 33 fluid catalyst units are now in operation or under construction.

Proud as the company's engineers are of the installations which have contributed so largely to perfection and increased production of aviation gasoline and other products, much of their interest now centers around the perbunan and butyl rubber plants at the refinery. The production of synthetic rubber has a fascination for the oil industry which will not easily be snuffed out when, and if, the importation of natural rubber is resumed.

Butyl rubber, a "specialty" product which has shown unusual resistence to oxidation and the action of acids, and high impermeability to gases, was developed by SONJ scientists as early as 1937. While it cannot compare with Buna S for tire-making purposes, it is said to retain air many times more efficiently than natural rubber and is far superior for the manufacture of innertubes, life-rafts and items of like nature.

A large proportion of isobutylene and a small quantity of isoprene go into the manufacture of butyl rubber. The isobutylene is a refinery gas produced on the premises and the isoprene is derived from turpentine or oil. Liquified under very low temperatures, the two are treated with a catalytic agent and rapidly heated at around 150 degrees F. to stop chemical action. A latex similar to that of natural rubber is formed by the resulting molecular change; water is screened out in dryers and the sticky mass is milled and rolled into long strips.

Buna N, or Perbunan, rubber also is made at the Baton Rouge refinery. Butadiene and acrylonitrile, combined and stirred with a catalyst, are the basic ingredients. Following their initial chemical treatment, they are washed and purified, coagulated by the introduction of acid, dehydrated and milled into fine crumbs that are pressed into sheets and shipped in cartons to the rubber companies. This rubber has been proved invaluable in the manufacture of self-sealing aviation gas tanks and for other specialized uses.

To laymen, the Butyl and Buna S processes appear quite similar. Both products undergo the washing, heating and compressing treatments and are rolled into shaggy, brownish strips. The product does not resemble the finished rubber until it has been further processed and vulcanized and this is done by the rubber companies. However, with the exception of the sampling of light and heavy oils taken from the fractionating towers, rubber-making is virtually the only "visible" process at the refinery. Visitors at the plant are fascinated with the steaming vats; the oscillating metal belts on which the white curds are dried by "bouncing"; the fleece-like appearance of the product as it comes off the rollers and the mats of rough, brownish, semi-transparent "rubber" which are packed in cartons for shipment to the processing plants after the final operations at Baton Rouge.

Synthetic rubber shown rolling out of an extruding machine. A few hours before, this rubber was in the form of two refinery gases. Production of Butyl is expected to reach 38,000 tons a year at the Baton Rouge refinery by the end of 1943.

This butadiene plant uses the butylene dehydrogenation process. The butadiene is delivered to a nearby co-polymer plant which combines it with styrene to make Buna S.

Approximately 38,000 tons of Butyl rubber will be made annually at Standard's Baton Rouge plant, out of the government's total goal of 75,000 tons a year. The perbunan plant, which went into operation in April, 1941, with an initial capacity of 1600 tons, has since been expanded to 3650 tons.

One of the most important synthetic rubber operations in the Government's program is located in the Baton Rouge area, just outside the boundaries of the Standard refinery. This is the Copolymer Corporation's new 30,000-ton Buna S plant, the first wholly government-owned synthetic rubber plant to go on stream.

Using butadiene from the Standard refinery and styrene shipped by tank car from Texas City, Copolymer Corporation turns out Buna S rubber —the real answer to the country's tire shortage.

Butadiene, extracted directly from cracked gases at Standard refinery or recovered from the dehydrogenation of butylene, is polymerized with the styrene at the Copolymer Corporation's plant. Under an exacting process where the temperatures have to be constantly checked, the two chemicals are mixed in drums with a soapy emulsion and a catalyst until the proper molecular structure is obtained. In glass-lined tanks, the reaction is carried on for 16 or 18 hours when the milky emulsion, or latex, is ready to be coagulated, screened, washed and dried in a process similar to that used in the butyl and Buna N plants nearby.

A staggering investment has been made in the Baton Rouge plant since the start of the war. To an estimated $50,000,000 pre-war investment, $48,500,000 has been added for the synthetic rubber program alone. Of this, about $34,000,000 is government funds. Another $32,000,000 of private capital has gone into the 100 octane installation, plus $7,800,000 for the manufacture and research of synthetic chemicals, such as alcohols.

Production figures on the 100 octane program were unavailable because of wartime restrictions. Likewise, there were plants that were not visited during the tour of the refinery.

Extreme precautions are taken at the plant. Guards patrol the fence surrounding the refinery and circulate constantly through the plant itself. Matches are picked up at the gate from each visitor and the only smoking permitted is done at small shelters, constructed for the purpose in open areas where there is no chance of igniting fumes or gases from the various units. A carelessly lighted match would provide good news for the Axis.

The Baton Rouge refinery is so breath-takingly enormous that visitors with only a few hours to spend on a tour of inspection find it difficult to sort out the myriad impressions received on the trip through. A sense of the physical vastness of the plant probably is the first impression, but a realization of the vastness of accomplishment involved—the manner in which the company has thrown all of its technical, financial and physical resources into the task of producing for the war effort—soon follows.

Many of the plants are still in process of construction; others are undergoing certain conversions that will permit them to produce in greater quantity, or faster, or using materials that are more readily available. Complete expansion will not be reached until 1945.

But daily, even hourly, the production figures are mounting. Production of 100 octane is now more than the production of ordinary motor gasoline at Baton Rouge before the war. Secret products are holding the attention of the military experts. The output of synthetic rubber is comforting to the Office of the Rubber Director.

No one could visit Baton Rouge without experiencing a definite lift in spirit. The petroleum industry, beset with all its troubles of shortages in transportation; in production; in materials, is making—in the estimation of many writers who visited the Baton Rouge refinery in June—one of the greatest contributions to the successful prosecution of the war.

Butyl rubber comes out of the polymerization plant as small curds floating in a water stream. Operator holds a handful of curds. When dried and milled, the curds become sheets of solid rubber.

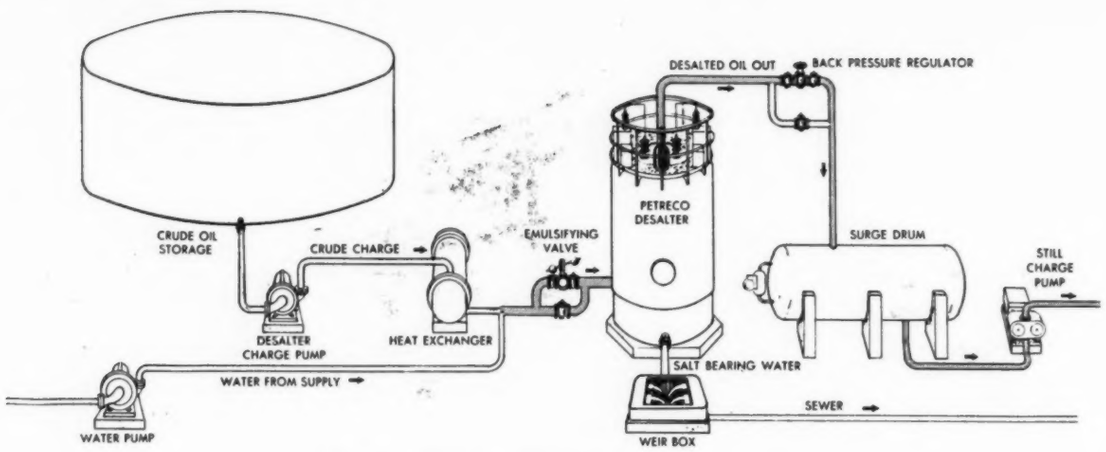


Diagram illustrates Desalting Process and indicates relatively low temperatures and pressures.

EFFECT OF SALT REMOVAL on Refinery Operation

Prevention of Corrosion, Plugging and Scaling Prolongs Life of Equipment and Reduction in Loss of On-Stream Time Promotes Economical Operation

As CRUDE petroleum is produced from the well, it is usually accompanied by water in varying amounts. The water content, generally referred to as B. S. & W. or M. & B. S., obviously limits the utility of the crude as produced. Purchasers of petroleum place limits on the acceptable water contents, such limits varying from 0.5 percent to 3.0 percent. In many cases, a premium is paid for the 0.5 percent oil, thus emphasizing the importance of a low water content.

The reduction in water content of the crude oil to meet the purchaser's specifications constitutes a major problem in production work, generally being accomplished by means of the electrical or chemical dehydrating processes. However, since complete removal is difficult, a small amount of water usually remains in the oil when it reaches the refinery.

In the majority of oil fields, the water produced with the oil contains large amounts of dissolved salts. The oil field waters encountered in connection with refinery desalting operations are brines which range in concentration of salts from that of sea water to virtually saturated solutions.

The salts found in these brines will vary according to the field from which the oil was produced. The chlorides are most abundant, but sulphates are also present in appreciable proportions. The most prevalent of the chlorides is sodium, with calcium and magnesium next in order. These salts, together with sulphides in some sulphur bearing oils, can be found in practically all types of crude.

The accompanying tabulation shows the quantity of water extractible chlorides found in various types of oils which have been tested in Petreco laboratories. These oils were taken from refinery charging stock, and in some cases represent mixed crude being delivered by large pipeline systems.

These tests indicate that the oil from practically all the large producing fields in the Mid-Continent, Illinois and Michigan areas, as well as many others, contain large quantities of salt. It should be noted that the values in the table are for chlorides only, and do not include other salts such as sulphates and bicarbonates.

Producing State	Type of Crude	API Grav.	Cut BS&W	SALT ptb*
Arkansas	Schuler	33.7	0.3	77
California	Santa Maria	14.7	0.8	88
"	Ventura	28.9	0.6	64
"	Wilmington	18.0	0.7	102
Illinois	Illinois Basin	37.5	0.1	77
"	Illinois Basin	30.1	4.0	1200
"	Illinois Basin	30.2	1.0	318
Kansas	Mixture	34.1	0.2	47
"	Kans.-Okla. Mixt.	34.4	0.6	112
"	West Kansas	32.8	0.1	70
"	West Kansas	36.8	1.3	238
Louisiana	Lake Long	40.7	0.2	20
"	Rodessa	39.7	1.2	256
"	So. La.	36.9	0.3	51
Michigan	Mixture	35.0	0.2	142
Oklahoma	—	19.4	0.5	87
"	—	31.5	0.2	154
"	—	19.3	3.6	1750
"	Mixture	38.3	0.2	24
"	Okla. City-Burbank	37.6	0.5	35
Texas	Panhandle	38.4	0.4	279
"	Gray County	41.5	0.8	336
"	Ector County	34.1	0.5	156
"	East Texas	36.9	0.6	130

* *Pounds of chlorides (as NaCl) per thousand barrels of oil.*

If the adverse effects of salts are to be avoided crudes such as those listed should be desired

before charging to the refinery. Determining the salt content of refinery crude stock is now routine in most refineries and this determination is not difficult.

Corrosion is one of the most serious of the adverse effects on refinery equipment caused by a salty crude charge. The annual cost of corrosion in refineries is a major expense to which it is difficult to assign a total value since it includes many factors other than the direct cost of replacements and maintenance. Although much progress in combatting corrosion has been made through metallurgical improvements and through development of neutralizing chemicals, neither of these procedures attacks the problem at its source.

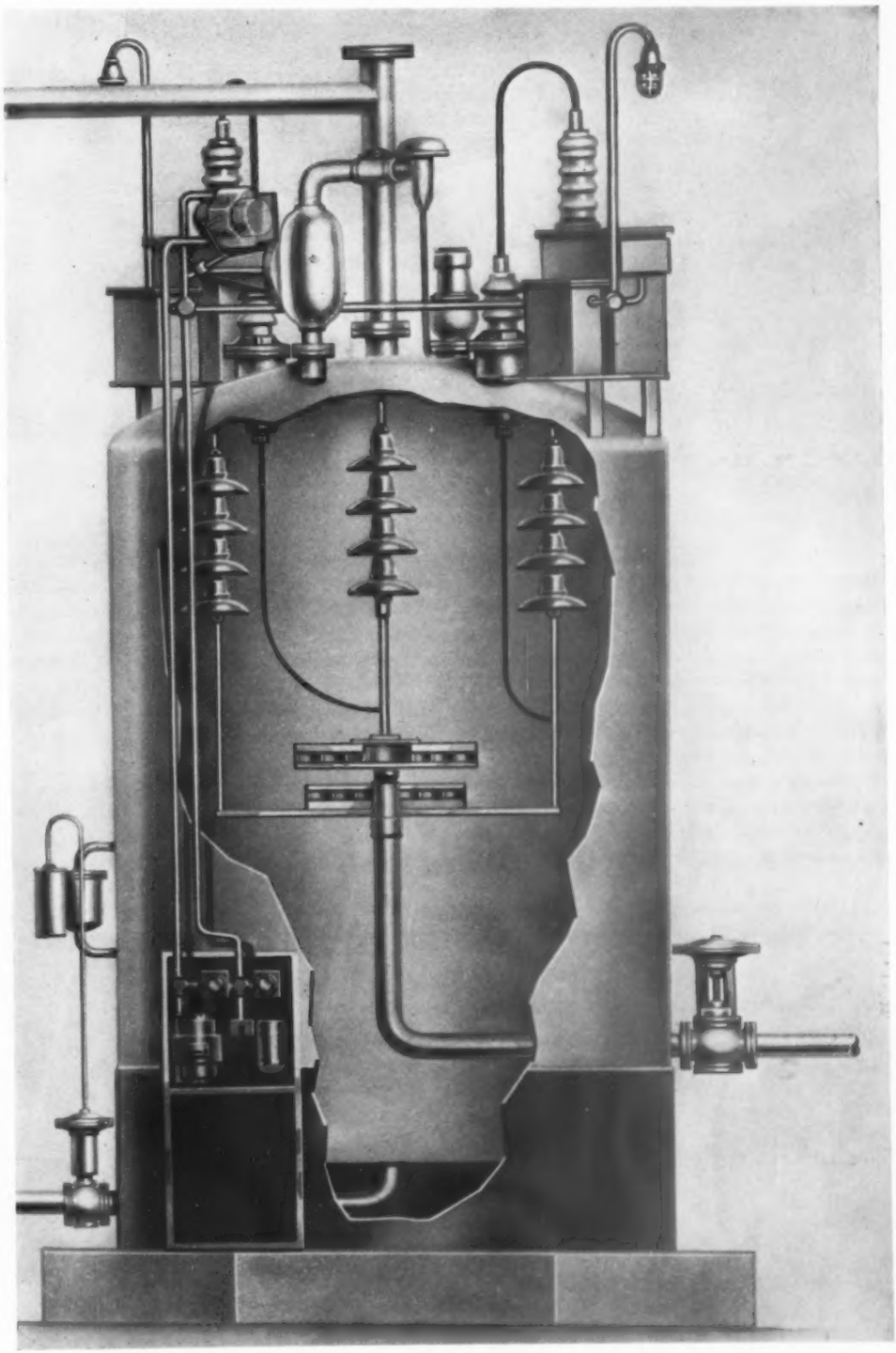
The salts present in oils incompletely or nondesalted are a frequent source of corrosion in furnaces, towers, transfer lines, cooling and condensing units and other refinery equipment. Magesium chloride in charging stocks readily decomposes at high temperatures, liberating the very corrosive hydrochloric acid. Calcium chloride undergoes similar decomposition especially in the presence of the organic acids always associated with crude oils. Furthermore, repeated quantitative experiments in Petreco laboratories have demonstrated that even so stable a salt as sodium chloride also liberates hydrochloric acid in the presence of suitable organic acids under distillation conditions. The percentage decomposition of the several classes of chlorides in crude oils (to form hydrochloric acid), when subjected to distillation conditions, depends upon the total chloride content of the oil, upon the nature of the salts present, upon the strengths and concentrations of the mineral and organic acids in the oil, to a certain extent upon the water content of the oil, upon the maximum temperature attained, and on other refining conditions.

Heretofore it has been considered that refinery corrosion due to hydrochloric acid would not be appreciable when the oil contains a total of calcium and magnesium chlorides less than some 10 to 15 pounds per thousand barrels. From the foregoing discussion, however, it is obvious that such amounts of calcium and magnesium salts can be highly corrosive. While it is difficult to assign any arbitrary limit to the total salt content of an oil below which corrosion due to hydrochloric acid will not occur, it is certain that maximum chloride removal will result in a minimum of corrosion. The chloride content of an oil, below which appreciable trouble due to hydrochloric acid corrosion will not be expected, depends upon the nature of the salts present, the properties of the oil, and the refining conditions imposed. In any event, the tolerable chloride content will be relatively low and all charging stocks should be carefully tested for potential corrosion.

Hydrochloric acid corrosion of refining equipment is widely recognized as a serious and expensive operating problem. Obviously, a highly efficient removal is required in order to reduce salt content to the necessary low value. It is therefore most important to the refiner that a dependable desalting process be employed.

Cooking is another costly trouble caused by a salty crude charge. The deposition of coke in refining equipment, especially in furnace tubes and other cracking equipment, and also in shell stills and heat exchangers, is inescapable when processing crude oils at high temperatures. The coke from salty oils differs from that deposited from salt-free oils, and often the rates of deposition differ widely. The coke deposited from salty oils contains a relatively high percentage of salts, sometimes amounting to as much as 50 percent or more. These salts fuse on the metal and act as nuclei for the deposition of additional carbon. Such deposition materially decreases on-stream time and is harmful to refining equip-

Below: Cut-away view of Petreco Desalter.



Petreco desalters in a mid-continent refinery.

ment. It retards heat transfer and promotes over-heating, blistering and rupture of tubes. It is also harmful in accelerating hydrochloric acid corrosion, since the salts are retained in high concentration and in close proximity to the metal.

A further harmful effect of salts in the coke is that they serve to increase its hardness and density, thus increasing the difficulties in the cleaning operations, with consequent wear and marked reduction in equipment life, plus the increased time and labor costs.

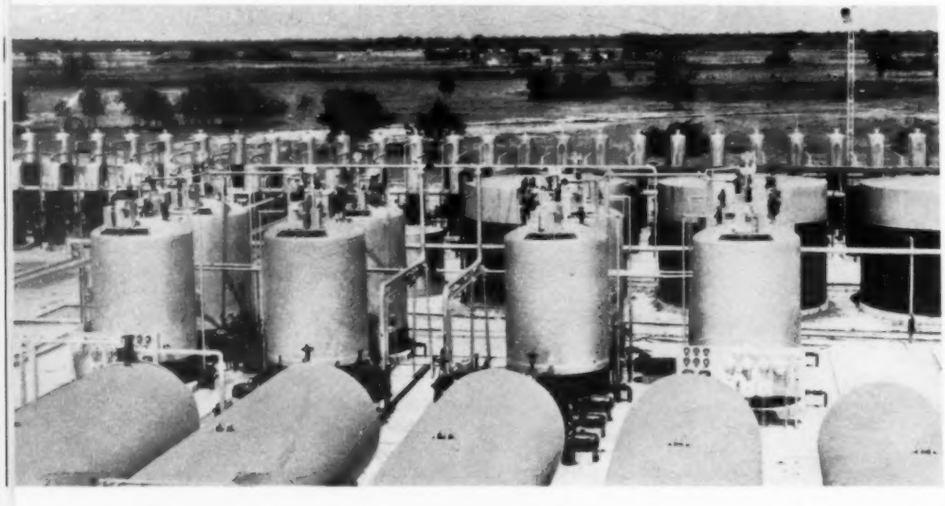
Plugging causes frequent shut downs for cleanout, and is one of the most severe process limitations imposed by salt. It is due to the accumulation of crystalline salts in exchanger and condenser tubes. As these salts accumulate, the efficiency of the heat exchangers is impaired, and the retarded flow through the exchangers results in increased pressures on the refining equipment. Such plugging necessitates costly clean-outs and losses in on-stream time.

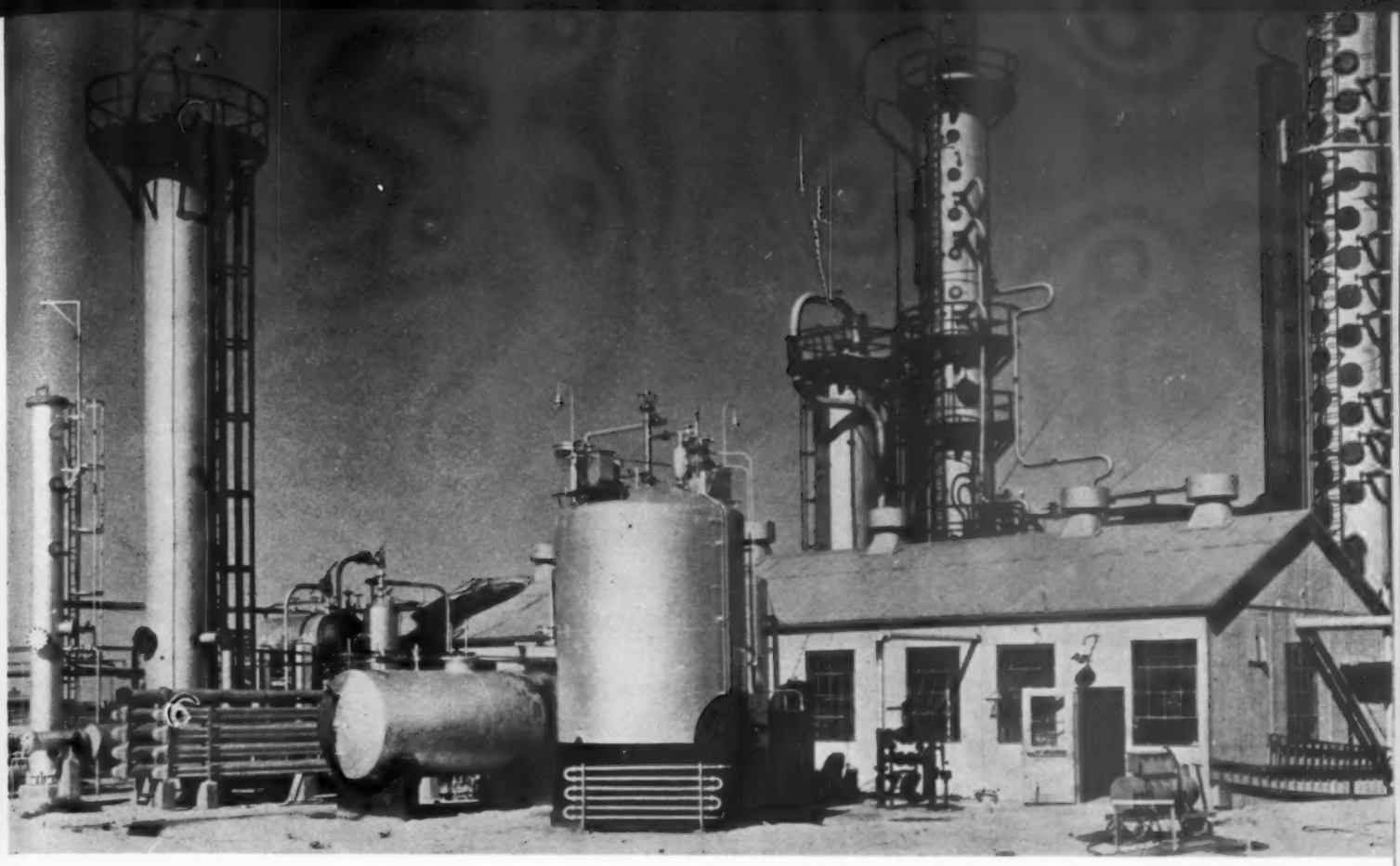
Scaling is another process limitation caused by a salty crude charge. It results from the deposition of scale-forming salts such as calcium carbonate and calcium sulphate. These scales are extremely hard and build up on the inside of lines, condenser and exchanger tubes, curtailing throughput, retarding flow and preventing efficient heat transfer, and are very difficult to remove. Pieces of scale frequently become loosened and are carried along by the oil flow until they reach an exchanger where they lodge in the tubes and contribute to severe plugging.

When the charging stock is adequately desalted, the reduction in the deposition and hardness of the coke is often readily apparent, and plugging and scaling due to salt are virtually eliminated. Fuel consumption is reduced by maintaining high rates of heat transfer. With plugging eliminated, on-stream time is increased by preventing the build-up of high back pressures. Equipment life is prolonged through the absence of over-heating, acid corrosion, scaling and over-stressing of metals. Cleanouts are fewer and less costly and incidental damage to equipment is minimized.

While corrosion, coking, plugging, scaling, and the production of inferior products are the most important specific difficulties for which salty crude is responsible, their cumulative effect, lost on-stream time, is of greatest concern to refinery management. The cost of equipment replacements, made necessary by metal losses due to corrosion, is always accompanied by a shut-down for repairs, adding lost manufacturing time and labor expense to the replacement costs. Coking is even more harmful in its inroads on operating time. It not only necessitates frequent shutdowns, but also impairs heat transfer and tem-

An eight-unit Petreco installation in the Gulf Coast area.





Single unit desalting plant in Kansas.

perature control, and causes still pressures to rise excessively. Furthermore, when the coke deposited is hard and glassy, as is almost inevitable with salty crude, the power tool drill-out is accompanied by considerable metal loss from grinding.

Lost on-stream time is a serious and costly hindrance to refining operations, yet there has been a tendency to accept limited runs and periodic shut-downs when charging certain crudes as inevitable. While metal inspections are recognized as a required safety precaution, frequent forced shut-downs for clean-out and repairs required by salty crudes are not necessary.

The analytical results obtained in testing for salt content are variously expressed in terms of grams per barrel, pounds per thousand barrels, or other units, depending on the basis upon which operations usually are conducted. In the United States, the preferred units are pounds per thousand barrels of oil of 42 gallons each. In order to facilitate conversion into any desired units, the accompanying table of conversion factors is included.

Petreco plants now operating in the United States have demonstrated the applicability of the process in the successful treament of a wide variety of oils from various Gulf Coast, Mid-Continent, Illinois and Michigan fields. The gravities of these oils have ranged from 17.8° API to as high as 44.0° API, and the salt contents from less than 10 p.t.b. to over 1700 p.t.b. In all instances the results obtained are remarkably effective, regardless of the type of oil being treated.

CONVERSION FACTORS FOR SALTS IN CRUDE OILS

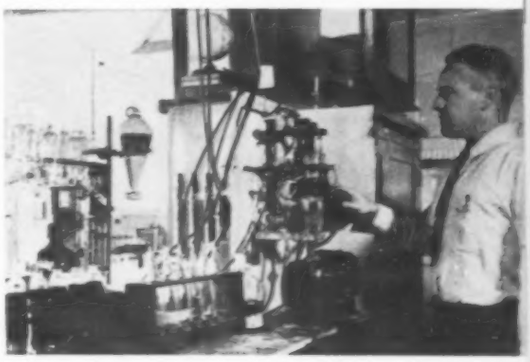
mg. per liter (1)	grams per bbl. (2)	pounds per 1000 bbls. (2)	grains per U.S. gal.	grains per B.I. gal.	grans per metric ton (3)
1.	.159	.350	.0584	.0701	1.176
6.29	1.	2.20	.367	.441	7.40
2.85	.453	1.	.167	.200	3.36
17.1	2.72	6.00	1.	1.20	20.1
14.3	2.27	5.00	.833	1.	16.8
.85	.135	.298	.0497	.0596	1.

(1) Approximately the same as "Parts per million" (P.P.M.)
(2) 1 barrel = 42 U. S. gallons.
(3) For oils of specific gravity 0.85 (35° A.P.I., 34.7° Bé.) at 60° F.
NOTE: *When it is desired to compute approximate salt content of oils from analyses of the brine, it is necessary to multiply those results by 1/100 of the total water content (expressed in percent) of the oil.*

One essential characteristic of a satisfactory desalting process is that it be incorporated into the refinery system in such a manner that the charging stock may be treated "on-stream" without an intermediate prolonged settling period. The Petreco process requires no separate settling step, the water separation taking place within the electrical unit. Desalted oil leaves the top of the electric unit and is charged directly to the refinery, while the water containing the extracted salts is continuously withdrawn from the lower portion.

Fresh water from available sources is employed for mixing purposes. Distilled water is not essential, as boiler feed water, waste water from the condenser boxes, or fresh well or river water are suitable in most instances. Exhaust steam is often used to bring the water up to the required temperature. The proportion of water used varies considerably with different charging stocks and the degree of salt removal required, satisfactory operation having been obtained with some oils with as little as 5 percent by volume of water, while with others as high as 20 percent is used.

Laboratory Desalter.



WOMAN'S PLACE IS EVERYWHERE IN THE OIL INDUSTRY

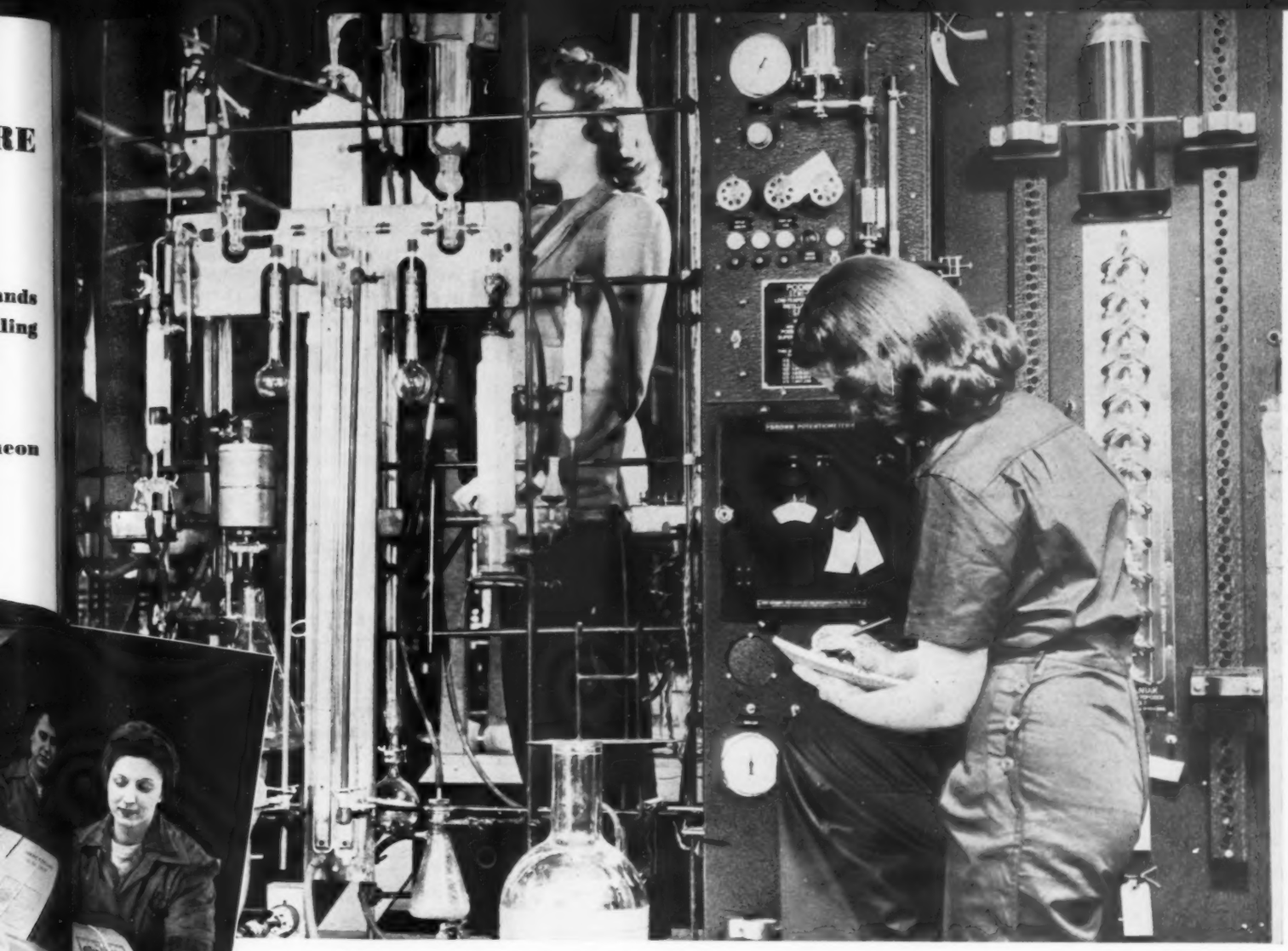
Thousands of Earnest Workers, Many with Husbands or Brothers in the Armed Forces, Are Ably Handling Jobs Formerly Reserved Exclusively for Men

By June Guncheon

Left: One of the women in the Barrel Preparation Department of one of the Socony-Vacuum Oil Company's refineries, shown on the job.

Right: Girls at work unloading paper cartons from a delivery truck at the grease works of the Standard Oil Co. of Indiana.

Below: Scene at the Esso Laboratories, with woman worker intent on her job.



In the Paratone laboratory of Standard Oil Co. of New Jersey these girls seem right at home in a maze of equipment.

TURNING back the pages of history, we find that women have always had a helping hand in man's fight for freedom. From baking bread in open ovens to feed hungry and weary soldiers to loading the guns so that they might fire more rapidly, women have made their contributions on all battlefronts in all ages.

Today, we find women again stepping up to play their part in this global conflict. True, many of them have donned uniforms peculiar to some particular branch of the military service; many are in civilian defense regalia, but there are a legion of others who work in overalls or in plain, everyday garb who are doing behind-the-scenes jobs that indirectly knock Zeros out of the skies and send tanks hurlting over Axis lines. Among these are the women who have taken over men's jobs in the oil industry. This rugged, he-man industry in many of whose divisions the mere presence of a woman was anathema is now finding that women are doing men's work with equal efficiency and in many instances with an efficiency and accuracy never before brought to the particular task. Actual stories and case histories of women on the job in the petroleum world will best serve to show just how far along the employment and training of women in this field has advanced since the war.

It was not long after Pearl Harbor that Continental Oil Company's president inagurated plans to alleviate the increasing shortage of manpower. A program to train women as laboratory testers for the company's Ponca City, Oklahoma, refinery was formulated and a special laboratory with modern equipment was established for this purpose. In addition it was also necessary to erect a building containing lockers, showers and dressing rooms for this new contingent of female workers. The company says that following the public announcement relative to the fact the company proposed to train and employ women as testers, their Personnel Division was literally swamped with applicants. Only 135 candidates, however, were given the rigid examination required. The examination papers were graded and those with the highest ratings were interviewed by a special committee composed of the supervisor of processes for the company, the chief chemist and the chief tester of the Ponca City control laboratory. This committee selected 15 candidates for the first class; the second and third classes started a short time later.

In a modern laboratory in this refinery, 28 women graduates of a rigorous training course are now satisfying their desire to "do something" in the war effort. They have mastered the secrets of the test tube and are now making tests to assure uniformity in quality of the company's products used in the fighting machinery of American and other Allied nations. These women work in 8-hour shifts, both day and night.

"The course of study outlined for women testers compressed into a six weeks' course what had

No stranger to a drill press was Mrs. Thelma Ellis. She completed a war-time vocational course before going to work as a machinist's helper at the Shell Oil Co. Refinery in Houston.

previously been equivalent to a two-year college course or a year's apprenticeship," the company tells us. "The supervisor and teacher of the classes is A. H. Erwin, chief tester in the Ponca City control laboratory, a veteran of 20 years in the control laboratory and a former instructor in college extension work.

"College work cannot be remotely compared to the rigorous training to which these women's classes are subjected. Instead of the usual 15 or 16 hours of class work weekly which the college student experiences, the future testers put in a 40-hour, 5-day week. They attend classes from 7 a.m. to 3 p.m. one week, and from 3 p.m. to 11 p.m. the next week. Classes cannot be 'cut' without legitimate reason because war work is important and expensive!"

The training course is also somewhat expensive, so only those who are really serious about the work qualify for the training. For instance, at Continental, the course costs the company $300 in addition to training pay, plus three blue denim uniforms free of charge to the student, and a textbook which is the American Society for Testing Materials Manual.

This is the way the training laboratory at Continental operates: the first two hours of each 8-hour class session are devoted to a lecture by Mr. Erwin or one of his three assistants, all of whom are from the control laboratory staff. These lectures explain tests to be made later in the day, answer questions on current assignments and review work that has gone before. On the bulletin board is posted a daily work sheet assigning tests for each student.

Following the lecture period, the women go to their testing tables and spend the remainder of the day making tests which are the same as those they will conduct in regular work in the control laboratory following their graduation. Frequent repetition of these tests makes for accuracy.

"Accuracy," says the company, "is a must in the control laboratory which is the pulse of the entire manufacturing program. Here a sample of every product is checked for uniform quality on every one of its 25 or more complex steps toward tank car and shipping case. A sample of each finished product is then filed and catalogued in the 'retain' room of the control laboratory and kept there until it is in the service of the ultimate consumer as a check against the possibility of contamination in transit or in storage.

"So important is this phase of the manufacturing operations that a tester must exercise delicate precision in every computation and the new women testers are meeting the exacting requirements of the job in full measure."

A few examples of the type of women that are in this group might be of interest. One has a husband in the Merchant Marine. She applied for a tester's job because she wished to augment her government income and also because she wanted to do her part in the fight for freedom. Another has a husband and a brother in the Army; still another has two brothers in the Navy and her father is helping to build the "Big Inch" pipe line which will move crude oil from Texas to the ration-cramped East Coast. This woman's mother is working in a powder plant in Arkansas.

Since Pearl Harbor this firm has hired over 500 women. In addition to these laboratory testers, three of the company's seismograph crews now employ women for the first time as assistant computers. These crews, which scientifically map oil structures, travel from one location to another wherever the search for crude oil production may lead. The women computers travel with the crews and work in temporary field offices. Their duties include the labeling and cataloguing of data incidental to calculations of structures from the seismograph records.

Continental's Mailing and Stationery division which formerly employed a woman as stenographer, now has seven women on a staff of thirteen. The staffs of the Pay Roll division and the Order and Distribution division also have several women. There is a woman draftsman in the Land Department, a woman does fingerprinting and photography in the Personnel department and there are girl file clerks in the Engineering division.

"Although Pearl Harbor can be named as the real cause for this readjustment," says Contin-

Right: Miss Betty Siler, assistant computer with one of Continental Oil Company's seismograph crews, at work in a temporary field office. Three of the company's seismograph crews, which scientifically map prospective oil structures, now employ women as assistant computers.

ental Oil Company, "personnel figures show that the rapid conversion of women to men's work started in July 1942. Up to that time, the trend was not noticeable."

The Standard Oil Company of New Jersey has taken on some women workers and from Mrs. Charlotte Lochhead of their Public Relations Department comes an interesting story about a 20-year old girl who holds a position in their fuel oil sales department.

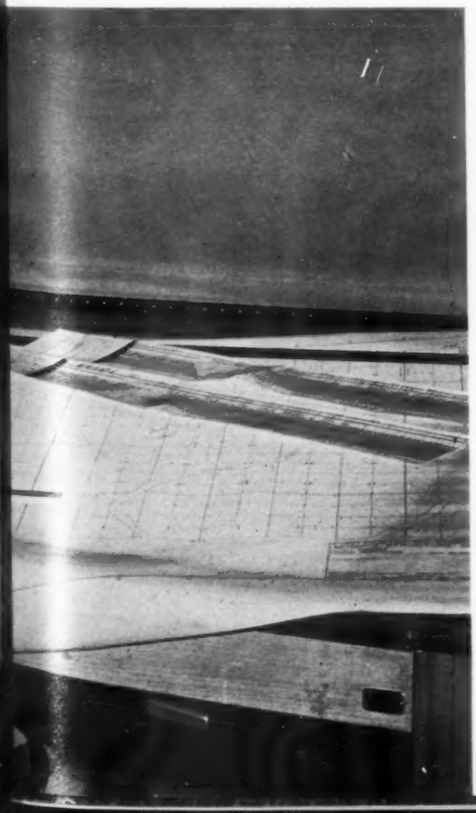
"When one of the shipping clerks enlisted in the Navy," she said, "this girl was given the opportunity to try out the job. She has made good, earning for herself each day new praise and confidence from the head of the department. She schedules and arranges the supply of our marine fuel oil products in New York Harbor for delivery from the refinery to all types of marine craft such as tug boats, cargo ships, troop ships and naval vessels. She arranges for tug boats and barges to deliver to a certain location so many barrels of fuel oil at a stated time. She is on call 24-hours a day, Sundays and holidays included, because the nature of her work makes this imperative. The ships have come to seem personal to her.

"This shipping clerk's job is only one of the jobs in this company which have been assumed by women. There are girls working as chemists on aviation gasoline and synthetic rubber in the refineries. The employment of girls as pages and at the reception desks was among the first of these innovations, but now girls are taking men's places in the credit department, the accounting department, traffic, sales, research and statistical, chemical products, manufacturing and shipping departments. These girls are not doing stenographic or ordinary clerical work. The jobs range in importance and responsibility, but most of them call for making decisions, for interpreting reports and statistics, for the direct handling and servicing of customer accounts (even accounts of $3,000,000). In such positions, if a girl makes a mistake, it would not be a paper error that could be erased, but one which would affect the movement of men and ships and tank cars."

Most of the girls who have been taken on by the Standard Oil Company of New Jersey have had some business training, some have also had a college education. In the manufacturing department which schedules all oil supplies, one girl with a college background in chemistry and mathematics works on company statistical reports on aviation gasoline and stocks. Another one follows details of the movement of crude oil via pipeline and tank car to the company's refineries as well as maintaining statistics relative to crude supplies. Another college graduate in this department assists in preparing the general stock reports for company distribution and records which also go to Washington from this department. She is responsible for the interpretation of the increases and decreases shown in the reports. She must know if a change might be a significant trend or is only something of the moment and must therefore know the reason behind the change. All of these jobs might have been filled by young men seeking a career in the oil industry had it not been for the war, but women are keeping these jobs alive until the men return. One of the department heads at Standard Oil Company of New Jersey said he was very enthusiastic about the accomplishments of the women in his department. "We expect them to work as hard as the men," he stated. "No preference is shown to the feminine part of the office. If the work keeps the office force late, the women must 'roll up their sleeves' and wade through to the finish, too."

In continuing the account of the part that women are playing in their activities, this company says that one business girl of experience who considers her present job "fascinating" work is employed in the fuel oil sales department in the division which has charge of contracts for the transportation of cargoes. This particular girl handles industrial accounts in addition to duties involving fuel oil contracts with the United States Navy. She contacts customers directly and they call her from all over the country. At first, in surprise they exclaimed, "Oh, a girl!" But this surprise soon subsided in a quiet wave of silent admiration. She handles the correspondence on these accounts, gets their credit ratings from banks, and in a great many ways carries vitally important responsibilities on her feminine shoulders. She handles any number of boats, knows them all by name and their usual requirement of fuel oil.

Those in charge of hiring the women at this company claim that personality and appearance still play a big part in all of these replacement jobs. Many of the junior clerical and typist jobs do not get as high a type of girl as before the



Top: Photo showing women in training to become testers in Continental Oil Company's refinery at Ponca City, listening to a lecture by A. H. Erwin, control chemist.

Center: Mrs. Luther Abel and Mrs. Murle Rhodes switching in an East Texas oil field near Gladewater, taking the places of men who have entered the armed forces.

Bottom: Girls at work in the carpenter shop at the Shell Oil Company's Houston refinery.

war, but in all of these other positions, such standards as good grooming and personality are even more exacting. The girls must be neat and businesslike in appearance and manner; they have to possess tact, patience and fine sensibilities of human relations so as to win for themselves status in the office as efficient and congenial workers.

Many are probably wondering what is to happen to all of these women who have taken over men's jobs after the war is over. Mrs. Loch head of Standard Oil Company of New Jersey gives us some interesting thoughts on this subject:

"In our own company," she says, "the girls who are replacing men in jobs understand that these jobs are for the duration, because our employees who have gone into the service have been guaranteed their jobs back after the war. However, there is no doubt that many of these girls who have proven themselves so valuable will be retained by the company in the same or similar positions after the war."

Socony-Vacuum reports that they also have been employing women in jobs formerly held by men in many scattered types of operations and thus far have had good results. Certain types of work have been found, naturally, to be more adaptable to women than others. For instance, in the packaging operations there has been little hesitancy in using women, especially where there is no heavy lifting involved.

In one of their plants women are inspecting drums, putting in plugs and washers, painting drum heads, stenciling, weighing the empty drums, marking the tare weight on the drum head, filling drums, and acting as weighers in scale houses. They are even unloading empty drums from box cars. They're also being used for filling and packing grease cans.

Another of the Socony-Vacuum plants is experimenting in the employment of women in the mechanical department. As an example, one girl who had no previous industrial experience has been trained in the use of the following equipment: turret lathe, bolt machine, drill press, light lathe and power hack saw. She also has been taught to grind her own tools and she gives general assistance in the tool room. Another girl with no previous industrial experience is now being instructed in welding. In each case the experiment has been exceptionally good, the company reports.

Two girls in one plant are being used in the instrument department. One spends her entire time on bench work and the other, in addition to some bench work, is working out orifice calculations and assisting in other mathematical calculations. Girls have been found to be efficient in the job of changing charts, and they are also being used as messengers.

This company reports that girls are proving very apt in the general work in control laboratories as physical testers. In the company's general laboratories they have been employed to take the place of male technicians, chemists, physicists and other specialists in science who have been called to the service. In addition there are many clerical operations in the refineries and laboratories which were formerly performed by men but which are now carried out by women, such as stenographic work, storeroom and stockroom activities, as well as many of the "run-of-mine" clerical jobs.

In the general offices, the company says that the use of women in all types of clerical work has been extended as the need arose. Routine building jobs such as elevator operation have, of course, been taken over by women.

The change-over to the employment of women in company-operated service station operations, says Socony-Vacuum, has been gradually taking place over the past year or so. At the request of its dealers the company established a training school for women employees so that they could be given the proper background and training before appearing on the driveways of the stations.

When word got around at Shell Oil Company's Houston refinery that women were about to make their appearance, many a man shook his head as if he could not believe it had really come to pass. The first female invasion was carried out by four girls who took over jobs in the laboratory that were formerly held by men. Shortly after this, eight more were selected for their mechanical knowledge obtained in vocational war schools and these women were sent to join the Engineering Department as general helpers. Still another contingent was sent to the field so that within a comparatively short time the number of women in the Houston refinery, not including the office staff, rose to fifty-seven. Among the jobs that these women are doing are: dispensing tools and supplies in the storeroom, helping to wrap insulation around hot pipes that criss-cross a refinery, helping the pipefitters to keep that maze of lines in repair, driving trucks, wielding tongs and sledge in the blacksmith's shop; several bang away at steel plates while others are boilermakers' helpers.

The management of the refinery worked out a 4-day training course for the recruits preparatory to their taking over their respective jobs. Several trips through the refinery are an integral part of the training to enable the new employees to get their bearings, more particularly to show up those who are physically unable to "take it." These trips include tank climbing, climbing ladders and several miles of walking. The "softies" soon crack under the strain and so leave before the actual training begins, thus saving time, effort and money for the company.

In hiring women, the company says that preference is given to single women over 21 years of age who have had some previous instruction either from vocational school or experience in some other industry. The fact that many companies in this section of the country seem to have their eye on women of this type has created a shortage of women in this age limit with experience so the majority of feminine workers in the Houston refinery are married women whose husbands are in the service.

The Head Fire and Safety Inspector, M. D. Daeschner, conducts the 32-hour training course for the women employees. Among the subjects covered are: a history of the company, instructions on company rules and regulations, extensive plant trips, safety rules, operation of refinery units, blackout procedure, first aid instruction and fire extinguishing. A very complete instruction in fire extinguishing is given since in many cases, part of the job is fire fighting. This instruction includes the selection of proper extinguishers for use in fighting oil fires, electrical and gas fires and any other types which might flare up.

The Texas Company reports that some women have taken over jobs in their laboratories, others, who are more of the Amazon type, load trucks. A booklet for dealers is now in preparation so that women employees at service stations may have a little training before taking over those jobs.

Practically all American oil companies are employing numbers of women in these or similar capacities, taking them on as the particular needs arise. At one time "a woman's place was in the home" but it is to be wondered now just where a woman's place rightly is, for she has taken over jobs in many fields of endeavor formerly considered completely foreign to the feminine hand. What is more she is doing these jobs with a sincere and earnest effort resulting in gratifying success.

One of the girl cyclists acting as guides at the Bayway Refinery of Standard Oil of New Jersey.

WAR'S EFFECT ON OIL INVESTMENTS

By Paul S. Stacey

Influence of Prospective Monetary Depreciation and Post-War Adjustments —Oil's Strength as Basic Product — Exceptional Position of Oil Royalties

Paul S. Stacey, Ph.D., economist and authority on finance, was born in Vienna, Austria, and graduated from the Universities of Vienna and Berne, Switzerland. For several years he was with the Department of Foreign Exchange and the Austrian Creditanstalt. Subsequently he was made a member of the Presidential Committee of all the Chambers of Commerce and Industry of Austria and was Austrian Delegate to the International Chamber of Commerce in Paris. In this capacity he worked out a system of clearing the blocked debts in Central Europe. Following the Nazi invasion of Austria he went to Switzerland and later to the United States where he has since been engaged in business as a broker and investment counsel. His interests in the oil business in Poland provided a rich background for this study.

IN TIMES of peace the investor considers only the essentials of security and profit. In a world at war he is faced with a multitude of problems and finds it more difficult than ever to decide on dependable, lucrative investments. Necessarily, then, he must study not only his own problems, but he must definitely consider the principles governing present-day economic changes. All commercial analysis must supplement specific figures with general considerations.

The following observations treat of the characteristics of present day economic trends. To understand those trends fully is to understand, as far as it is possible, economic conditions to come.

Real Mechanics of War Payments

The United States is financing the present war, not with foreign loans but by internal taxation and the sale of national war bonds. Taxation really means a definite renunciation on the part of the individual of repayment by the state. Borrowing, on the other hand, creates new debt claims within the nation. Yet this domestic pseudo credit cannot change the fact that it is the community itself, that is, the nation, which is defraying the cost of the war at the moment when the expenditures are made.

The United States is waging the war on a "pay-as-you-go" basis. Therefore, only a gradually increasing proportion of national income, and at no time national wealth, will be used to pay for the war, however long it may last. That portion of national production diverted to war consumption must be withdrawn from civil consumption. It is this withdrawal that constitutes the only real payment for all war expenditures of the United States.

Payment for the total cost of the war is made by the renunciation of material goods. The lowered standard of living for the duration is virtually the cash payment and corresponds exactly to the amount of expenditures for the war. When peace comes, the only visible remnant of this temporary and limited lowering of the standard of living will be an internal debtor-creditor relationship. Hence the war is paid for during the emergency by public privation, and not at the time of ultimate redemption of war bonds.

Purchasing Power of the Dollar

The question of the development of the purchasing power of the dollar is one of paramount interest to the investor. He sees four possibilities, on which depends whether he will consider the currency situation of primary importance or whether it will be subservient to security and profit.

The first possibility is based upon the surmise that the fixing of ceiling prices and the ever-increasing siphoning-off of private purchasing power will eventually stop the retrogressive movement of the dollar. This possibility always exists despite the fact that there has been a material increase in the cost of living since the beginning of the war in 1939.

The second optimistic view foresees the general stabilization of currency with increases in ceiling prices in exceptional cases. In the long run these increases in ceiling prices caused by decreased supply, rather than on the money side, is not disturbing since this condition will be rectified with the resumption of civilian production.

The third possibility foresees a slow decline in the purchasing power of the dollar despite attempts to maintain ceiling prices and siphoning-off of purchasing power. This is the stage of the development of the dollar that we are witnessing at the present time.

The fourth possibility is that governmental regulation will prove ineffective because the forces of economics will prove to be stronger than the forces of regulation. The ultimate outcome of this struggle would be a collapse of the dollar.

The realization of either of the first two possibilities need not influence the choice of investments, but the third and fourth possibilities must necessarily influence the decisions of the investor. The latter two possibilities mean that the investor will turn away from money and from all things which bring monetary returns in fixed quantities.

In this connection there is one fact which must be apparent to all who ponder economic questions seriously: today, contrary to the first world war, the mechanism of currency devaluation is thoroughly understood. Measures to prevent depreciation of purchasing power are so comprehensive that it can be emphatically stated that there is no likelihood of another inflation such as annihilated all currency values in Europe in the 1920's, thereby eliminating the fourth possibility.

Their remains, the third possibility, continued gradual monetary depreciation. If those measures already proved efficient, were augmented by those drastic measures that are still in the discussion stage, consumer income would be reduced by:

1. New tax legislation (introduction of a general sales tax, etc.).
2. Decrease of all income at its source by means of:
   (a.) Deduction for taxes, war bonds, etc.
   (b.) Increased deduction for old age security and other benefits.
   (c.) General limitation of all income.
3. Shelving purchasing power through use of post-war purchase priorities.

Complemental regulation of expenditures would comprise:

1. Establishment of ceiling prices for all goods and services with a few exceptions being made for works of art and entertainment.
2. Rationing all articles of consumption.
3. Control of spending by a variation of the English Kalecki proposal limiting expenditures to a certain percentages of taxable income.

Here, there seems to be little leeway for currency movements except for criminal black markets. Nevertheless, even such a controlled system of economy can hardly stabilize the purchasing power of the dollar.

In the first place, the ideal condition of adjusting free purchasing power to balance the production of consumer goods can hardly be achieved due to constantly changing conditions. From the start, purchasing power was greater than the amount of civil goods produced, and this unbalanced situation is constantly and mechanically renewed through payment for the war effort. The siphoning-off of purchasing power in excess of the supply of consumer's goods is an interminable problem.

Since this migratory purchasing power to a large extent originates in the lower income brackets and cannot be perfectly controlled, it leaves unimpeded the demand of the masses for consumer goods. Unimpeded demand is also present among the wealthy classes since higher standards of living cannot be reduced immediately. There is a rigidity to a high standard that is not due to the mere disposition to continue to enjoy luxury.

Hence a man in the higher-income brackets seeks the middle way out of his difficulties. As a temporary expedient he will liquidate or borrow on his wealth in order to partially compensate for the reduction of his income, even though he would be penalized by taxation within the frame of the defeated spending tax plan.

Limitation of Income

As long as reduced income can be supplemented with capital the siphoning-off of income will be only a half-way measure and its purpose (the radical reduction of demand) will not be completely attained. True, the demand for higher-priced commodities will decrease, because only in exceptional cases will luxuries be purchased by liquidation of capital. It may also be noted that insofar as these funds are used to maintain households and charitable contributions they increase the income of all their recipients and in turn increase the demand of the masses for articles insufficiently on hand.

It may appear contradictory that overwhelming demand can influence monetary value even though ceiling prices and rationing cards protect the desired goods from price increase and purchase. However, experience shows that decreases in monetary value are brought about indirectly.

If everyone in the nation is allowed to purchase a maximum of four pairs of shoes annually, it is clear that this does not mean that thereafter those who in peace time bought only two pairs should now increase their consumption. The government arrives at this figure of four pairs upon the basis of shoe stocks on hand and statistics of previous consumption. However, because of increased income, large sections of the population may suddenly begin to hoard within the law by buying the maximum shoe allowance. Then, despite rationing, there will be a shortage. In such a case the government can either reduce the amount of shoes for sale or can reduce the number of buyers by raising the individual price-ceiling.

Increasing ceiling prices are, in an objective sense, the simple expression of monetary depreciation. Quota restrictions with stable prices lead to the same result but with other indications. Despite the apparent maintenance of money's purchasing power, a subjective decrease in monetary values takes place which finds its expression in a decreased utility for money by its possessor. Quota restrictions taking the place of price increases have caused the concept of money previously held to change. Obviously money no longer can be considered the general medium of exchange. Formerly its possession could buy any desired product by paying the price but now it has become less useful because of restricted stocks. Money will become less desirable as more and more commodities are made unapproachable even at higher prices. The subjective estimates of money value must decrease in accordance with its increasing uselessness.

Transformation of the Idea of Money

Useless as a means of exchange for necessary commodities, its decreased value now will be expressed in terms of abnormally high prices for those goods and services prices of which the government has no real interest in controlling such as furs and other luxury goods. Even if, in this connection, the need of the individual is satisfied, the remaining unusable monetary surplus urgently searches investment.

Under these conditions a peculiar form of impoverishment is likely to take place. Controlled economy impoverishes the utility of money. One by one the marks of its old sovereignty disappear. Unlike the gold meter bar, money itself becomes unreliable because it has now become a flexible measure of value. It is no longer suitable for hoarding. Exchange for its equivalent in metal has been made impossible by law.

Money is no longer "rhythmical." Its birth and death no longer are in accord with production and consumption. In view of the inadequate production of peace-time goods, money remains, in part, without any economic equivalent. It is no longer the life-blood, but the oedema, of economy and must be tapped to avoid loss.

Even the last great function of the dollar is vanishing. The superiority of the well-to-do buyer is constantly diminishing. In a like manner the recipient of increased wages will soon be able to exchange his additional income, not for desired commodities, but only for those that are permitted. Money is gradually losing its characteristic of a universal medium of exchange and becoming merely a limited one.

Today we are witnessing a transformation of the idea of money. Stripped of its most important functions, it appears to be converted to a type of ration card divided into imaginary coupons; only a part will represent immediate purchasing power. The greater part cannot be presented in exchange for goods until peace-time when redemption will again be possible.

After due consideration of all the circumstances, one may venture to predict that the coming years might witness a gradual, but in no way alarming decrease in the purchasing power of the dollar.

The long-term investor consequently must consider the monetary element during the war period, but this constitutes only one phase. His decision must prove to be economically sound in the world after the war. To carry his investments unharmed during the war is but the first important step.

Today the economic contour of the post-war world in which the soundness of selected investments will be tested can be seen only vaguely. When victory comes for the Allies it will remove a colossal burden from humanity. More than one-half of all labor power thus far has gone to naught since, in some form or another, it contributed to offensive or defensive military use. Freed from the burden of military production, the abundance of commodities which can be produced in the freedom of a peace economy may make us forget our present limited consumption.

After victory, post-war consumption will be able to rise to a higher plane. At the same time the extremes of under-consumption and luxury consumption may be eliminated because the curtailment of income and wealth by taxation has as its corollary the ascent of the striving masses from unemployment to bourgeois existence. Viewed from the standpoint of consumption, this means additional demand for middle-class goods which, as a counterpart, will bring about a noticeable decrease in the demand for luxury goods.

Inflation Hedge

The purpose of a secure investment today is narrowly circumscribed. An investment can no longer be found that will conform to the past conception of an "inflation hedge." Formerly it had to fulfill two conditions. In the first place after the storm of inflation had passed it had to represent the same amount of buying power represented at the time of expenditure. Secondly, the returns on this investment had to protect and maintain the usual standard of living, that is, the increase in current income had to correspond closely with the depreciation of currency.

Today, however, the idea of a secure investment has a very different meaning. Naturally there is no difference insofar as conservation of capital is concerned, but no investment, no matter how flexible its returns, can prevent the decreased standard of living brought about by rationing during the war. Nevertheless, increased income during the war period which is not absorbed by increased expenses and taxation is by no means lost. The original consumption value of the unused income must be converted into savings value. Decreased use at the present time transforms itself into purchasing power in the future.

It is obvious that any type of investment which returns a fixed amount of money and makes no

provision for participation in profits, does not constitute a desirable investment. In this connection the peculiar status of War Bonds must be emphasized. It is unwise, and indicates misconception of economic relationships, to warn against all investments bearing a fixed rate of interest and thereby tacitly include War Bonds. Even if depreciation of the dollar would, for all practical purposes, wipe out the value of the interest, the loss of such interest would be but a small objection if the capital were preserved. War Bonds constitute an essential investment since even with increasing issue they not only maintain their own value but also the value of all other monetary claims. It is for this reason that a disparity between actual purchases of war bonds and ability to purchase is in the long run equivalent to economic disaster. Refusal to buy the full share of bonds at present is just as foolish as refusal in the last war to make use of cheap insurance against war damage, although in the path of destruction. Premiums are insufficient if the responsibility is left to one's neighbor, because the plan is efficient only if everyone subscribes.

Changes in Economic Organization

After exclusion of those types of investment in which there are relatively large monetary dangers, there still remains a wide field of possibilities. But an analysis of goods which retain their values intact during both war and peace brings us back to the question of the formation of the post-war world. It is probable that we are entering upon an era of gigantic economic blocks that will embrace several continents. Herein there will certainly be room for all kinds of production associated with the necessities of life: food, clothing, shelter, heat, power and transportation. However, the reverse side to this medal reveals a decline in the present policy of protectionism. After the transitional protection period, domestic industry will be protected only against becoming a dumping ground for countries where labor is much cheaper. Moreover, in the interest of most efficient supply, this country will have to compete against better and cheaper products from any section of the economic block entering its markets. Under such an aspect every commodity which may be dispensed with and replaced by another, becomes of questionable long-term value as an investment.

Irreplaceable demand can exist only in the case of elementary goods which constitute the basis of our production. Without these elementary goods the structure of civilization must fall. Thus forms of energy and matter which today cannot be thought of other than as foundations of our economy become the "categories" of our civilization, just as in the intellectual sphere, time, space and cause form the unchanging basis of human thought. Categories of a spiritual and material type transcend all discussion of their necessity.

Our entire future peace economy would certainly collapse were we to do away with the category "oil."

The kerosene lamp, the first great use for oil, for the first time freed men from the uncertain flicker of artificial light. Since the days of the kerosene lamp many more ways of producing artificial light have been found. However, petroleum has remained important because of new uses found for it.

The great era of the wheel is intimately bound up with oil. The wheel as a medium for the transformation of energy as well as the wheel which rolls over the streets is a true symbol of our present day technical advancement. Indeed language itself has evolved a double meaning for the word expressing the function of the wheel. "Revolution" not only signifies the action of the wheel but is a true description of the profound change resulting from it. The union of oil and the wheel is another step forward.

Oil was one of the primary factors in bringing about the technical progress that rendered obsolete use of the gruesome Malthusian theory. Its "repressive checks" namely, the lack of adequate food for the increasing population have now become outmoded and without foundation. The development of agriculture and the freeing of the farmer from many burdens that tied him to the soil have been brought about by oil.

However, the greatest use of oil is in the field of transportation. The development of the automobile and its attendant benefits is a story that is familiar to all. It is only necessary to reiterate that it was not until oil was tried as a fuel that the rapid development of automobiles occurred. As a counterpart to the existent cooperation between railroad and bus is the far more significant future symbiosis between ship and plane. Airplanes, powered by oil, are available for transporting masses of humanity and goods to the ends of the earth and distance is now fading into nothingness.

Health and beauty of mankind, medicine, cosmetics and the infinite abundance of dye-stuffs that make life more enjoyable, as well as safer, are all dependent upon oil. Synthetic rubber is only one of more than 300 by-products of modern oil cracking processes that only await the operation of peace time industry to contribute to man's happiness on a scale heretofore unknown. Only now is the world beginning to understand the vast possibilities of oil. The age of oil, growing quickly to maturity, is now upon us.

Oil and Ceiling Prices

Here it is fitting to ask whether oil, the foundation of our post-war economy, is suitable as a war investment. Oil as the vital war weapon will be less subject to boom profits than any other commodity because public interest will demand the cheapest prices for oil. In connection therewith the tendency is for ceiling prices of crude oil to move down to a level that will leave the producer but a very modest margin of profit. The realization of this tendency would result in a fixed ceiling and, in the event of a progressive depreciation of the dollar would bring about the diminution of profits. This in no way means that there would be a loss of principal. Even if this occurred oil would be a suitable investment for today.

However, it is now obvious that ceiling prices are not inflexible. In practice they are constantly subject to stress and strain both from above and below. Should one or the other pressure be more powerful, ceiling prices will move in the direction of the stronger. One must analyze the forces operating in individual cases.

Ceilings may be imposed that bring adequate profits, but where this is not true it is important to know whether any flexibility may be expected in the ceiling prices of the invesment possibilities under consideration. If such is the case there is not much danger that the relationship between ceiling prices and monetary values will become more disproportionate. One can characterize investments with a flexible ceiling as a partial inflation hedge. Hence much depends on how the forces affecting ceiling prices are composed in various investment situations.

Price Under Managed Economy

The theory of price-formation as developed in modern economic theory presupposed the free play of economic forces. It did not take into consideration the fact that today we are operating under a managed monetary economy. According to one of the cardinal tenets of modern theory the market price of a commodity is determined at a point that does not exceed the purchasing power of the weakest buyer, the so-called "marginal buyer," who is indispensable for the purchase of the commodity for sale. (A classic example is the price of bread in a free market. In order to fix its price at a level suitable for the weakest purchaser, all consideration of the enormous worth of bread and of the innumerable grades of purchasing power in the hands of wealthy consumers is disregarded.)

In a free economy, the price of crude oil at the beginning of the war should have risen because with conversion to a war economy there occurred a shift to more highly-valued end-products. This shift lessened the importance of the weakest marginal peace time buyer.

These tendencies had no bearing on ceiling prices. Prices were not adjusted according to the changed parallelogram of energies, but left unchanged in their position, historically defined. The situation as it affects the consumer will not be altered during the war since neither declining stocks nor declining supplies will be able to change prices. Scarcity of oil will result in nothing more than allocation in harmony with the importance of the production of individual products. Price increases will only reflect increased shipping costs. As increased purchasing power in a period of commodity-shortage cannot result in increased prices, the most important influence on prices, demand, becomes impotent. The problem, therefore, narrows down to the

question of whether from the standpoint of supply, production of crude oil, there is a drive powerful enough to bring about increased ceiling prices as an offset to declining monetary values. In common with all other production, crude oil determines its lowest prices by original costs. In all branches of production there is a question as to how high above original costs ceiling prices should be established. The influences acting on this decision are whether the public is interested in permanent and sufficient delivery or whether the various branches of production are dependent upon governmental benevolence. The government's interest in maximum delivery can coincide with the private interest of the producer so that the ceiling price can be set higher than the market price.

The experience of the first World War shows (and it can now be seen in England and Canada) that in most industries a ceiling can be maintained without any appreciable increase just as long as there is no serious stoppage in the production of goods. In a strictly managed economy such a danger will be avoided as long as the government continues to allot raw material and labor at fixed wages to industry in order to keep it going. An industry made dependent upon steady allotments can no longer successfully seek price increases, consequently it will seek its profits in quantity of production.

Factors Affecting Oil

However, the foregoing is not analogous to the petroleum industry. Here the government has a double function, that of user and protector of the consumer's interests on the one hand, and on the other, as the supreme protector of national resources. Hence there results a certain conflict of interests, and the superior state interest, that of the protector of oil resources, becomes decisive. Ultimately this is identical with the interest of the petroleum industry in increasing, or at least maintaining, oil reserves. As has been repeatedly pointed out present known reserves are sufficient only for about fifteen years.

Continued production of petroleum is possible only by discovery of new reserves. Calculation, therefore, cannot be based solely on present sources, it must take into consideration expenditures connected with increasing those sources. Whereas production costs in nearly all other branches of industry are accurately calculable, expenditures cannot be estimated in advance as to how much will be needed to discover additional reserves necessary to maintain our oil supply level. One must take into consideration a certain amount of chance, i.e., the gamble of discovery drilling. Herein lies the principal reason for expecting a certain adjustment of the ceiling prices of oil to a sinking currency.

Gambling on discovery-drillings is indispensable but cannot be made compulsory. It must be made attractive so that there will be no further decrease. There is certainly some incentive when discovery-drillings are encouraged through priority ratings for materials, through exceptions in well-spacing or possibly direct subsidies. All this, however, does not mean a substantial reduction of risk in connection with drilling operations. It is primarily the assurance that a producing well will yield a good profit which gives the necessary incentive to discovery drilling. Therefore it is the crude oil price which will be the decisive factor in the judgment of the drilling contractor. He must be certain that future proceeds from the produced oil will never yield a mere nominal profit. These profits will only represent real money when they keep pace with changes in the purchasing power of money. It cannot be seen how an increase in crude oil prices can be avoided if there is to be a continuation of exploratory drilling in the future.

Thus even in a controlled economy, the fundamental laws of economics play their part. The "marginal" costs influencing the price of oil are the costs of the yield of the most expensive discovery-well whose drilling is vital for the maintenance of natural oil reserves. The profit of this contractor must be respected and will serve to keep the ceiling prices always under control.

Thus we have the situation that it is not the production of approximately 400,000 existing wells which will determine the ceiling price, but it is the small number of indispensable discovery drillings which will be the strongest factor for a flexible ceiling price.

Recently developed secondary recovery methods are playing an increasingly important part in enlarging supplies of oil. Secondary recovery methods aim at producing such oil supplies as can no longer be removed from the producing wells by artificial flowing or pumping. This is brought about by the introduction of liquids or gases which increase natural gas pressure and which raises the "dead oil" to a higher surface.

Just as discovery wells must yield sufficient return to warrant their commencement, the costly installation of secondary recovery methods must be made worthwhile. Even though the gamble is much smaller in the latter case, the decision will rest upon the price obtainable.

Price Adjustment

It is obvious that ceiling prices will not adjust themselves to every minor change in monetary value. Rather there will be a certain tolerance of currency fluctuation.

This "dead" area of prices is well founded. It means that changes in prices up to a certain degree may be regarded as normal fluctuations resulting from variations in supply and demand. As long as there is a possibility for the pendulum of prices to swing the same distance in the opposite direction there is no need for the adjustment of ceiling prices. The need for adjustment first appears when the swing of the pendulum is disrupted and prices advance steadily in one direction.

It is to be expected that minor fluctuations in the value of money will occur without affecting the ceiling price of crude oil. However, as soon as the "dead" area is passed the motives mentioned above will express themselves in rising ceiling prices of crude oil.

When this point is reached one sees the value of oil investment as an inflation hedge. As with all ceiling prices, so the price of oil is not able to react immediately as in a free market. Like the hour hand, it follows in the wake of monetary action and thus fulfills the vital economic function of preserving capital.

Oil Shares and Oil Royalties

Oil investments as marketed on the stock exchange in the form of shares of oil companies comprise all phases of the industry: Production, refining, transportation, and marketing; this four-fold root of profits provides a strong investment foundation in normal times. It permits an internal compensation of risk and profit and is the basis for a relatively steady income.

However, in a controlled economy and in a period of a slowly depreciating dollar this combination, from the standpoint of profit, may not work out so well. It is to be expected that the price curves of the various products in the oil industry will not be parallel. There already have been instances of some of the important products, now necessary for our war economy, piercing through ceiling prices. Thus the producers of high octane aviation gasoline and its components, or of butadiene and styrene for synthetic rubber, profit from the old principle that the strongest incentive to development lies in the expectation of reward for extraordinary efforts.

Therefore, at the highest step of refinery production, prices are influenced by the same compelling motive which ultimately will be the decisive factor in the price of the first stage, crude oil. This is not necessarily true for those products of normal production routine which lie between the top and the bottom of the hydrocarbon scale and which need no further special incentive for their production.

As expenses for conversion and transportation are added, price-forming impulses emanating from the basic product become weaker. Therefore, it is uncertain whether prices of medium-valued oil products will be adjusted closely to monetary values. In any event, the medium-valued products which are important to the war effort would be the last ones affected by price adjustments. As flexible ceiling prices can hardly be expected in medium-valued goods, their production in a period of sinking dollar values will be at a reduced margin of profit and will diminish the total profits of the enterprise.

(*Continued on page* 56)

How about your crude?

If you are a refiner still making peacetime products the following statement is no news to you:

> Generally firm tone continuing in petroleum markets reflects the fact that *many refiners are in difficulties over the question of adequate crude supplies*

That is from Keith Fanshier's oil page in the Chicago Journal of Commerce, April 30, 1943

Further down in his column Mr Fanshier writes:

> No question about it; high octane aviation gasoline [100-octane] is needed in staggering quantities and ever greater ones

Refineries that can make 100-octane gasoline, any component of it or any other war product *must* have adequate crude supplies—and they do

It's wise and patriotic for every refiner to get into war production

Helping to convert refineries to war production is our job

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OIL IS AMMUNITION—USE IT WISELY CARE FOR YOUR CAR FOR YOUR COUNTRY

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THE REFINERS INSTITUTE OF PETROLEUM TECHNOLOGY

Foreign Oil Legion

John C. Case

JOHN C. CASE, whose career in the oil industry has taken him to many lands and through many branches of the business, was elected a director of Socony-Vacuum Oil Company at the annual meeting last month. Beginning in the offices of Vacuum Oil Company at Rochester, N. Y. in 1912, Mr. Case was shortly transferred to company headquarters in New York. During World War I he saw service in France and on his return was assigned to the manufacturing department of Vacuum, moving over to the producing department when it was formed in 1920. In 1925 he went to Europe in charge of producing operations and following the merger of Vacuum with Standard Oil Company of New York became manager of foreign production for Socony-Vacuum. In the past few years much of his attention has been given to the company's producing activities in South America.

At the same meeting Walter L. Faust, vice president of the company was added to the Socony-Vacuum directorate. Mr. Faust joined the Vacuum Company in 1929 in the marine sales department and was made general manager of marine sales when Socony-Vacuum was organized. Aviation sales later were placed under his direction and in 1938 he became manager of all sales in eastern territory. His promotion to vice president took place in 1942.

MAX W. BALL, who organized and has heretofore directed the activities of Abasand Oils Limited, engaged in developing the oil sands of the Athabaska region, has returned to his practice as consulting engineer with offices in Edmonton and Denver. Mr. Ball remains with the Abasand Company as consultant.

TERMINATING eleven years of service with Byron Jackson Co., Frank Champion has resigned as vice president and general manager of the Oil Tool Division, but will serve as a director of the company. Mr. Champion now is associated with Glenn H. McCarthy, as general manager of drilling and production operations, and will maintain his offices and residence at Houston. O. W. ("Ox") Morgan, Jr. has been appointed sales manager of Byron Jackson's Oil Tool Division and Garth F. Nicholson has been made works manager and chief engineer.

DR. E. O. BENNETT has resigned his post as chief petroleum engineer of Continental Oil Company to establish his own office as petroleum consultant with headquarters in the Mellie Esperson Bldg. at Houston, Texas. Dr. Bennett is a recognized authority on oil production methods, particularly on pressure maintenance and cycling operations. In 1942 he received the Hanlon award "for distinguished service to the natural gasoline industry" and in May last Texas A. & M. awarded him the honorary degree of Doctor of Engineering. A graduate of Stanford University, Dr. Bennett began his career in the oil industry with Standard Oil Company of California, was in charge of the research laboratories of the National Advisory Committee for Aeronautics at Langley Field during World War I and has been with Continental Oil Company since 1926.

D. T. O'CONNOR, formerly with Lago Petroleum Corp., Caracaibo, Venezuela, the Bahrein Petroleum Co., Bahrein, and more recently with Trinidad Leaseholds, Ltd., Trinidad, B.W.I., is now associated with E. L. Carter, export manager for the Shaffer Tool Works, W. C. Norris Mfgr., Inc., Wheatley Bros. Pump & Valve Mfrs., Tom Wheatley Company and the American Machinery Corp.

D. T. O'Connor

DR. F. M. SURFACE, manager of the sales research department of the Standard Oil Company of New Jersey, has been named to coordinate all sales research work for the foreign and domestic companies of the Standard Oil Company (N. J.). F. R. Ficken, head of the statistical division of the sales research department, has been promoted to Dr. Surface's former position.

Dr. Surface joined the Standard Oil Company of New Jersey in March 1933, prior to which time he had served the United States government in various capacities in the biological and economic fields. He was assistant chief of the statistical division of the United States Food Administration from 1917 to 1918 and was food statistician for the American Commission to Negotiate Peace at Paris in 1919. For six years he was assistant director of the bureau of foreign and domestic commerce in charge of domestic commerce, for the United States Department of Commerce in Washington.

Mr. Ficken started with Standard in 1926 as office boy in the treasurer's department, subsequently held various positions in the sales department and in 1933 was named head of the statistical division of the sales research department.

Ing. Enrique Butty *E. O. Bennett* *F. R. Ficken* *F. M. Surface*

IMPORTANT BENEFITS IN ONE REFINERY
From Petreco Desalting
★ Ammonia usage cut 50%
★ Asphalt solubility raised from 99% to 99.92%
★ Longer runs with cracking units
★ Less HCl evolved, reducing corrosion
These important benefits have been cited by an eastern refiner who has depended on Petreco exclusively for salt removal protection for over six years. With asphalt products an important phase of their manufacturing operations, the increase in solubility was especially important. Reduced ammonia usage, less corrosion and longer cracking unit runs are, of course, important benefits in any refinery.
It is more necessary than ever that vital refinery equipment be protected against the inroads of salty charging stocks. Petreco engineers are always ready to assist refiners in any problem relative to salty crudes. Why not avail yourself of their experience?
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INTERESTING INVENTIONS . . .

FOAM-REDUCER. Centrifuge rotors normally remove entrained air (and impurities) from liquids. But air is then remixed with the liquid as it discharges from the usual rotor. The ingenious liquid take-off shown below removes the purified liquid from the rotor almost foam free. Successfully used to centrifuge apple juice, floor wax, chemicals, etc.

Useful on many other liquids where foam is troublesome.

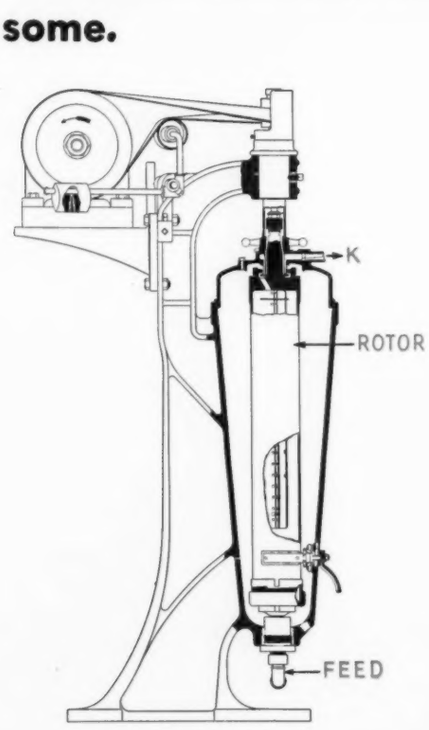

FIGURE 1

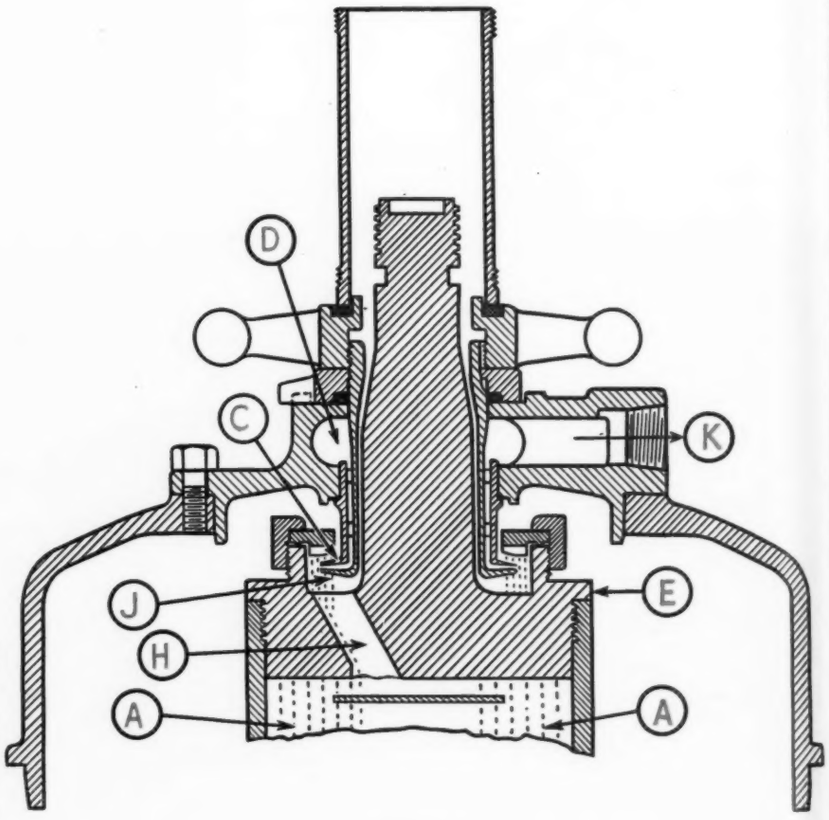

FIGURE 2

Fig. 1 is the complete centrifuge. Fig. 2 shows the head E of the rotor. The liquid A flows continuously into the bottom of the rotor, then out through the top passages H. At J the liquid is revolving rapidly and is, therefore, under a centrifugally generated pressure head. Upon entering the stationary annular take-off C, the liquid will no longer revolve, thus converting kinetic energy to static pressure. The pressure from J thus will force it into D and out K *under pressure* and *without access to air.*

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ARMY E NAVY

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry—Edited by Dr. O. W. Willcox.

DRILLING

A Wartime Wrinkle—Harry Wines, before DIVISION OF PRODUCTION, AMERICAN PETROLEUM INSTITUTE, Pittsburgh, April, 1943

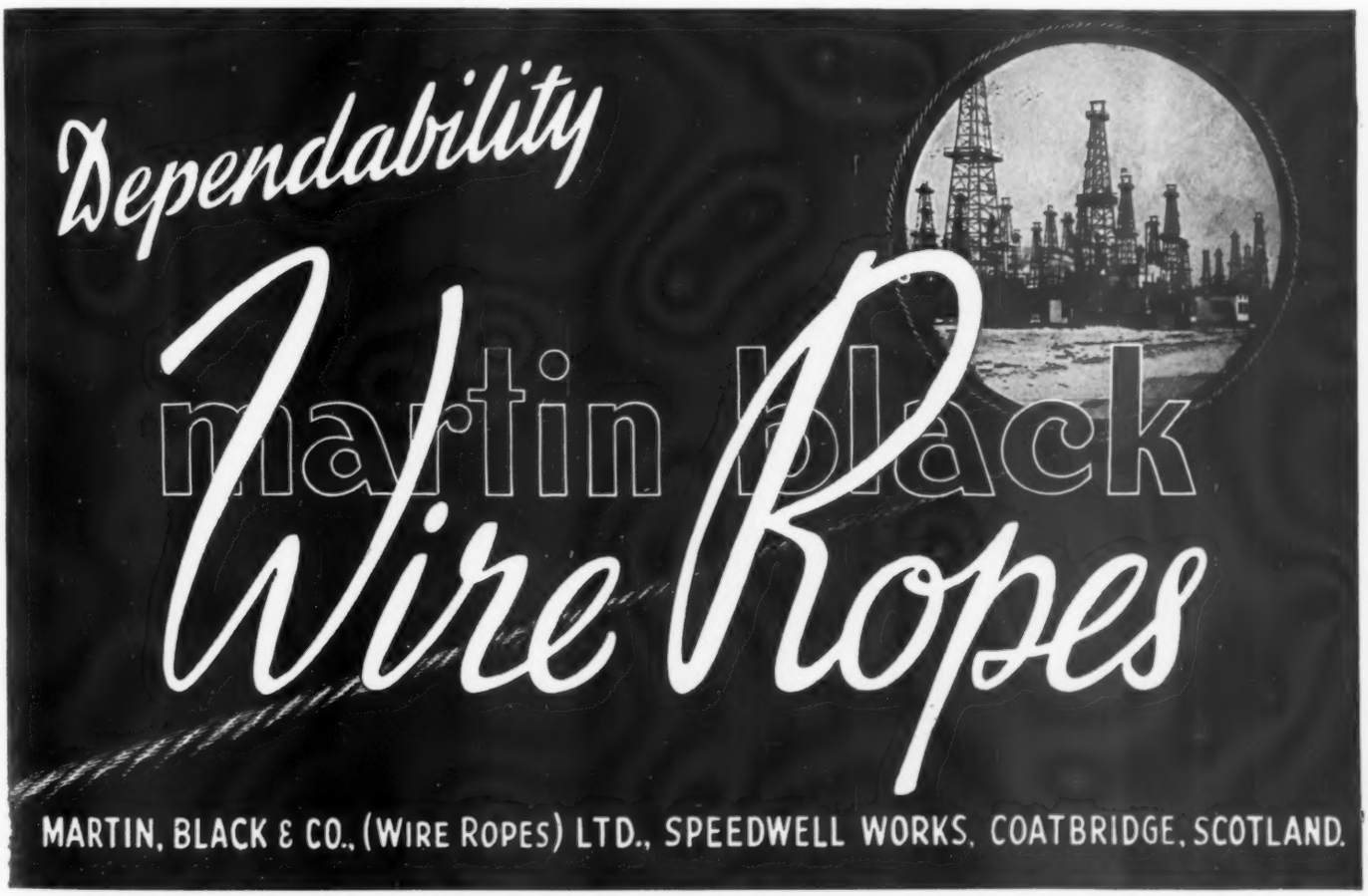
The shortage of steel for new rigs and repairs to old ones has caused some operators to try their cleaning-out spudders as deep hole rigs. Wells have been drilled to 6,000 feet with spudders. The spudder has many advantages over the standard cable tool rig. It is portable and can be moved and put in operation at a fraction of the time and cost of a standard rig. Another of its advantages is saving wear on the lines, since the driller can "goose" a spudder with the brake, rather than by slipping the line through the drilling clamps. The question may arise how to run 5,000 feet or better of casing weighing 55 tons on a spudder mast. One way of doing it is this: First run a string of 2-inch tubing to the bottom of the hole, then circulate a 6 percent aquagel mixture down through the tubing and up the outside to the depth at which casing can be safely run on the mast. Next, pull the tubing and start the casing in the hole with a float shoe. When the casing reaches the aquagel, or is submerged a ways, it will start to slow up. Speed of submersion can be controlled by pumping water inside the casing from time to time to give the required weight. By the time, or before, the casing has reached the bottom, it will have displaced the aquagel to the top of the hole, so the casing job and "geling" job are completed together. The reason for running the tubing and pumping from the top is that in open hole through shale and some slates that cave considerably, the washing effect of the "gel" going down the walls is likely to wash a lot of cavings down with it. Filling from the bottom is a slow rise in column and has a packing or compressing effect on the walls. The next question is how to start a string of pipe on such a flimsy mast. This is done by using hydraulic jacks until the pipe is free, and then switching over to the mast to finish pulling.

OPERATION

Brine Stabilization with Sodium Hexametaphosphate– F. W. Jessen and J. S. Battle, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 35 (1943), No. 6, pp. 650-654.

The present study investigates the possibility of using sodium hexametaphosphate in the stabilization of calcium carbonate in oil-field brines to be returned to subsurface formations. Although applicable in many instances where subsurface disposal is being practiced, the brine studied was produced from the Edwards limestone of Southwest Texas.

Treatment of this brine for disposal presents several difficult problems. Upon aeration, the high calcium carbonate supersaturation may be readily reduced to 5 p. p. m.; but in so doing, the hydrogen sulfide is oxidized to colloidal sulphur, which is highly dispersed and therefore difficult to remove by filtration. In addition, such treatment leaves a water saturated with oxygen; and when it comes in contact with the high-sulfide water in formation, colloidal sulphur again precipitates and tends to plug the formation. These factors seem to justify the use of a closed system, provided some means is found to stabilize the high calcium carbonate content of the water to prevent its precipitation on return of the water to the formation. A "closed system" in this case may be defined as a plant designed to exclude air (oxygen) from contact with the fluid in storage. In practice this is frequently obtained by maintaining an oxygen-free gas blanket (such as methane) over the surface of the fluid at 2 to 5 pounds per square inch gage pressure. An open reservoir covered with a 6-12 inch layer of crude oil is a practical means of approaching such conditions in the field. In contrast, an "open system" is one in which air is in contact with the fluid surface at all times.



The problem was to stabilize the calcium carbonate in the system. This was accomplished by treating the brines with two to five parts per million of sodium hexametaphosphate; they then are stable as regards precipitation of calcium carbonate for seven to fourteen days, which should give sufficient time for surface storage and subsequent disposal into the formation without plugging the interstices of the disposal sand body.

It is noted that the ordinary calcium carbonate stability test is not applicable to metaphosphate-treated waters. This est is therefore modified by pretreating the solid calcium carbonate with a concentrated solution of sodium hexametaphosphate to saturate the surface area of the solid particles prior to use for stabilizing brines.

NATURAL GAS

War Products from Natural Gas—Paul Raigorodsky and F. H. Dotterweich, before DIVISION OF PRODUCTON, AMERICAN PETROLEUM INSTITUTE, Pittsburgh, May, 1943.

The rapidly increasing tempo of war activities and decreasing reserves of crude oil dictate that all petroleum fractions shall be processed for their most efficient use in the war effort. This applies especially to the processing of natural gas and natural gasoline, wherein waste and devaluation of light petroleum derivatives has been much prevalent in peace times. Under war conditions these raw materials have become of great importance, in part due to their large volumes, and the low critical material requirement for their production and processing.

Since the war began there has been a great improvement in methods of fractionally separating the light hydrocarbons in a relatively pure state for transformation by thermol or catalytic cracking with remarkable yields of war products.

Details of many of the new methods for processing the light hydrocarbons cannot at present be revealed. They include among others, the Houdry one-stage and the two-stage catalytic dehydrogenation processes for converting butane into butadiene, the regenerative furnace method for efficiently cracking ethane-propane mixtures to ethylene, propylene and benzene mixtures, new methods for producing carbon blacgs, boosters for aviation gasoline, hydrogen from steam and natural gas for ammonia and explosives, etc.

These processes reflect a much higher field of utilization for natural gas and natural gasoline other than as a fuel and source of energy and tends to dictate that their true value will rightly be recognized by the petroleum industry in the near future. These developments offer the petroleum industry new fields and processes by which it may put to efficient use a portion of its product which heretofore has received little attention. It should be remembered that these developments have come during war time when the success of a process depends on the availability of/and raw material used by the efficient use of critical material required by the process. This condition appears to suggest that the majority of these processes are economically sound and the return to peace will see them established as permanent factors in national economy. Constant vigilance on the part of the petroleum industry relative to the great potential possibilities of natural gas and natural gasoline will not only materially aid in the production of war products required by our armed forces but will place this industry in a most advantageous position to convert to the production of the immense quantities of synthetic consumer goods which will most assuredly come with the return to peace.

IMPERMEX

OVERCOMES SALT WATER DRILLING TROUBLES

The use of IMPERMEX, a colloidal material for drilling with either salt or fresh water muds, has enabled operators to drill through salt overhangs without encountering drilling difficulties and without having to run a protective casing string. The unusually low water loss characteristics and the exceptionally thin filter cakes resulting from the use of IMPERMEX allow unhampered drilling and the free running of electrical logs in holes contaminated by salt zones ordinarily difficult enough to force the abandonment of drilling. More accurate formation information is disclosed through core analysis when IMPERMEX is used.

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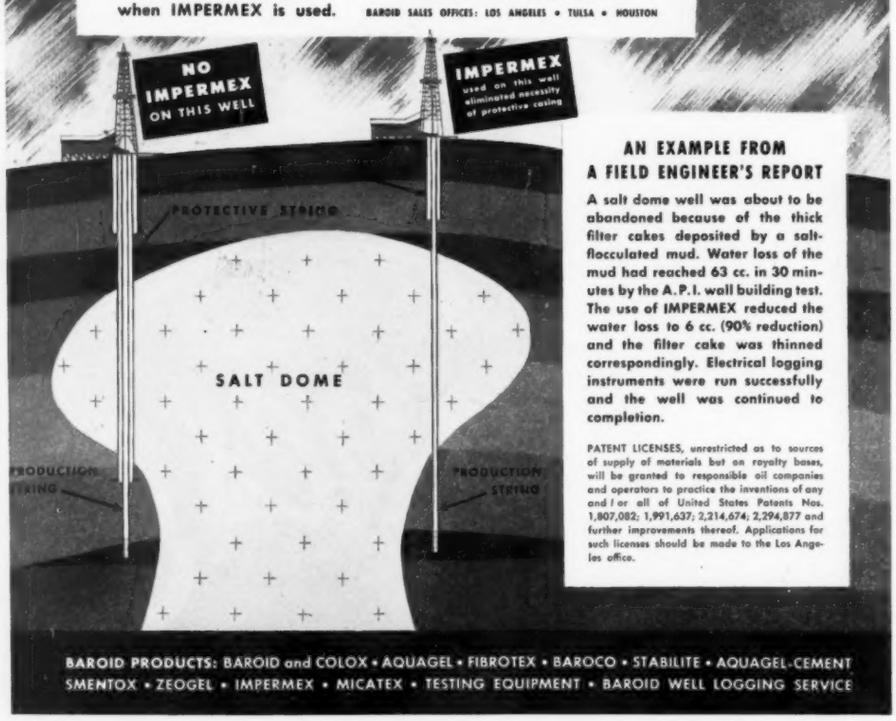


AN EXAMPLE FROM A FIELD ENGINEER'S REPORT

A salt dome well was about to be abandoned because of the thick filter cakes deposited by a salt-flocculated mud. Water loss of the mud had reached 63 cc. in 30 minutes by the A.P.I. wall building test. The use of IMPERMEX reduced the water loss to 6 cc. (90% reduction) and the filter cake was thinned correspondingly. Electrical logging instruments were run successfully and the well was continued to completion.

PATENT LICENSES, unrestricted as to sources of supply of materials but on royalty bases, will be granted to responsible oil companies and operators to practice the inventions of any and / or all of United States Patents Nos. 1,807,082; 1,991,637; 2,214,674; 2,294,877 and further improvements thereof. Applications for such licenses should be made to the Los Angeles office.

BAROID PRODUCTS: BAROID and COLOX • AQUAGEL • FIBROTEX • BAROCO • STABILITE • AQUAGEL-CEMENT SMENTOX • ZEOGEL • IMPERMEX • MICATEX • TESTING EQUIPMENT • BAROID WELL LOGGING SERVICE

CHEMISTRY

Cracking Cyclohexane—Vladimir Haensel and V. N. Ijatieff, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 35 (1943), No. 6, pp. 632-638.

The decomposition of cyclohexane at high temperatures and pressures, with and without alumina, has been investigated. In the absence of alumina, using a chromium-molybdenum steel reaction tube, methylcyclopentane is the isomerization product. The composition of the exit gas, formed both in the presence and absence of alumina, indicates that the cyclohexane ring splits at two points to give ethylene, propylene, and butylene as the primary products. At the same time cyclohexane dehydrogenates to benzene and hydrogene; the hydrogen made available destructively hydrogenates the olefins formed during the ring splitting. The composition of the gaseous products does not correspond with that predicted by the Rice mechanism. The liquid products contain cyclopentane, methylcyclopentane, cyclohexene, methylcyclopentenes, benzene, toluene, dimethycyclohexanes, m-xylene, and phenylcyclohexane. The postulated mechanisms for cyclohexene and methylcyclopentene include dehydrogenation of cyclohexane to cyclohexene followed by isomerization to methylcyclopentene, because it was found that methylcyclopentane does not isomerize to cyclohexane with the reverse reaction proceeds readily. The mechanisms proposed for compounds such as alkylbenzenes and alkylcyclohexanes involves alkylation of benzene and cyclohexane by olefins and paraffins formed during ring splitting. Alkylation takes place under the experimental conditions. The interaction of benzene and propylene produces toluene and m-xylene in small yields, but when either benzene or propylene is reacted separately, no toluene or m-xylene is

formed. Further alkylation, using toluene and propylene as well as toluene and propane, produces higher alkylbenzenes. Presence of an olefin increases yield of diphenyl from benzene since the olefin acts as a hydrogen acceptor.

REFINING

The Cyclization of Hydrocarbon Mixtures—S. J. Green, in JOUNAL INSTITUTE PETROLEUM, Vol. 28, (1942), No. 225, pp. 179-208.

The conversion of non-aromatic hydrocarbons into aromatics within convenient temperature range constitutes one of the most important advances in recent hydrocarbon chemistry. The process is attractive not only for the production of high-octane fuel, but also for the production of pure aromatic hydrocarbons. There are two general processes for aromatization, thermal and catalytic. In the thermal process the nature of the aromatic hydrocarbons produced depends on the temperature; in the catalytic process it depends on the catalyst and the feed. The thermal aromatization of heptane, for example, would theoretically lead to an equilibrium mixture of benzene and other aromatics, while the catalytic cyclization of the same hydrocarbon would produce toluene. In petroleum refining, cyclization of mixtures is more the order of the day than the aromatization of pure compounds, and such operations are influenced by reactions other than pure dehydrogenation—cyclization.

In these mixtures cracking to olefins and lower paraffins, decompositions and confused proportioning are serious competitors to cyclization. It seems, therefore, that to prevent undesirable reactions, in the aromatization of single compounds use should be made of a catalyst that activates only the C—H bond. A suitable catalyst appears to be one prepared from chromium nitrate on a carrier of activated alumina.

The author reports a large amount of laboratory data which will be of interest to experimenters in this field.

In general, the cyclization of hydrocarbon mixtures results in a spreading of the distillation curve, formation of gas and carbon and an increase in aromatic and unsaturated hydrocarbons. At the same time hydrogenation reactions take place. The product from such a reaction will therefore depend on the conditions of the reaction and the nature of the substrate. By the choice of suitable conditions, and by varying the composition of the substrate, it is possible to achieve several different reactions at the same time, using a single catalyst.

USES

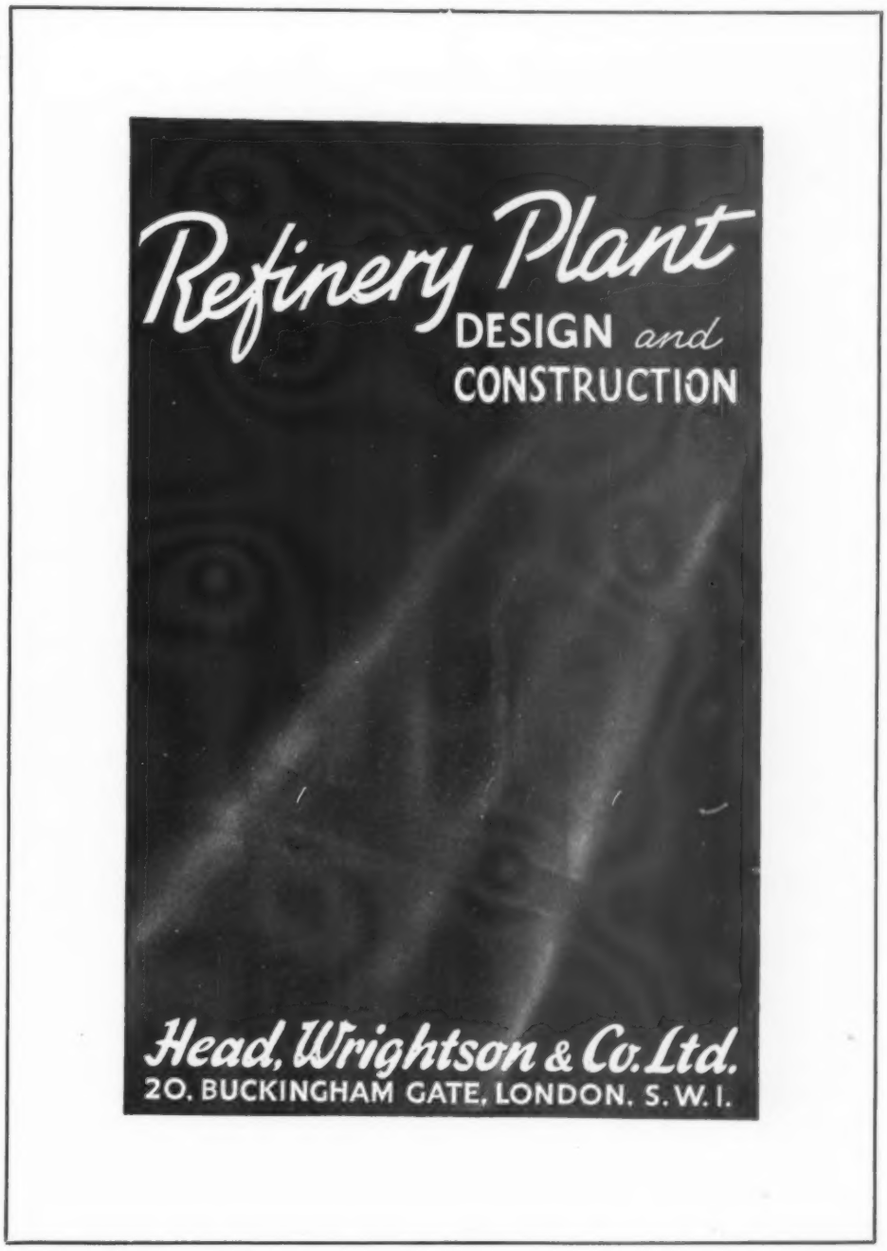
Lubricants for Ordnance Combat and Motor Transport Vehicles—R. E. Jeffery, before Diesel Engine and Fuel and Lubricants Meeting, SOCIETY OF AUTOMOTIVE ENGINEERS, Cleveland, June, 1943.

The author reviews the developments that have led up to the present standards for Army lubricants particularly for military vehicles operating on the ground. In writing the specifications for these lubricants there were a number of vital points to be considered. One of these is to reduce the number of types and grades so as to simplify the problem of supply, and what is of equal importance, to avoid disastrous misapplication of different types of lubricants by the troops in the field. The problem of simplification was complicated by the extreme climatic conditions to be met, from the frigid regions of the Alcan highway and Alaska to the torrid and dusty Sahara. Besides climatic adaptability the lubricants had to meet high requirements as to detergency and protection of engine parts against corrosion.

As a result of exhaustive consideration of the subject the Army now has one single type of engine oil in three grades: SAE 10, 30, and 50. (U.S. Army Specification 2-104A), instead of the previous two types and 13 grades. The effect of this simplification on the supply problem is great, and the chances of misapplication in the field are greatly reduced. A standard redilution practice was worked out for SAE 10 and 30 oils so that these oils give very satisfactory results in winter operations.

Gear lubricants were reduced from two types and seven grades to one type and three grades, one of which is SAE 50 engine oil for transmission, differential and final drives of tanks. Straight mineral gear lubricants have been eliminated, which obviates the inadvertant use of straight mineral oils in hypoid gears with disastrous results. For extremely cold regions an "artic" grade of gear lubricant, which could be used without dilution, was developed and is known as grade 75.

To meet the winter grease needs of ordance vehicles there are now two grades: general purpose "0" grease (winter chassis grease) and general purpose grease No. 2 (wheel bearing grease). An entirely new specification (AXS-934) now covers an engine preservative oil which will not only preserve the engine during shipment and storage, but will also permit the engine to be operated without damage until the oil can be replaced with the prescribed grade engine oil. The qualification as to rust prevention extends protection against humidity, salt water, and hydrobromic acid corrosion.



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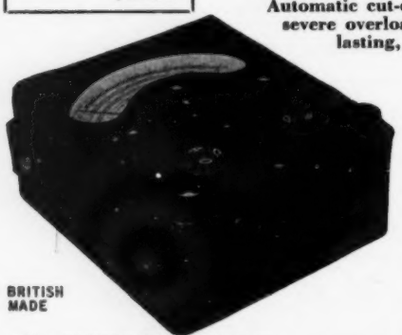

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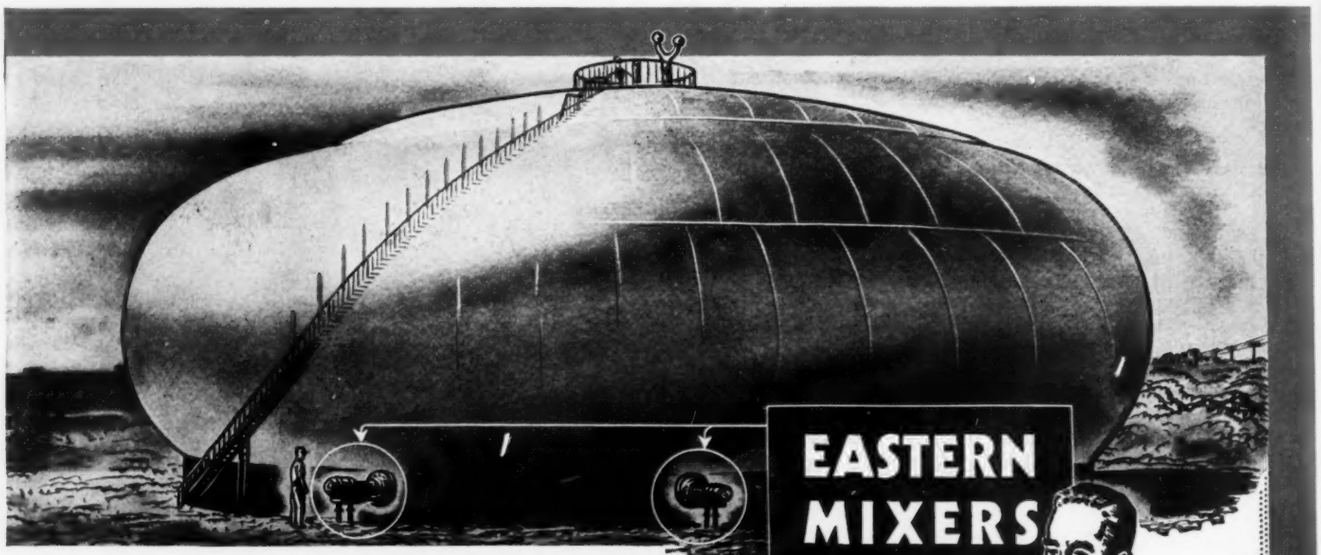

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